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FINAL TIER II SAMPLING AND ANALYSIS PLAN FOR SITE 16/F VAPOR INTRUSION  
GROUNDWATER INVESTIGATION NWS EARLE NJ  
2/1/2014  
TETRA TECH

# **Tier II Sampling and Analysis Plan**

**for**

## **Site 16/F Vapor Intrusion Groundwater Investigation**

### **Naval Weapons Station Earle Colts Neck, New Jersey**



### **Naval Facilities Engineering Command Mid-Atlantic**

**Contract Number N62470-08-D-1001  
Contract Task Order WE15**

**February 2014**

Project-Specific SAP  
Site Name/Project Name: NWS Earle  
Site Location: Colts Neck, New Jersey

Title: SAP for Site 16/F Vapor Intrusion Groundwater Investigation  
Revision Number: 0  
Revision Date: February 2014

**Title and Approval Page**  
**(UFP-QAPP Manual Section 2.1)**

**TIER II SAMPLING AND ANALYSIS PLAN**  
**(Field Sampling Plan and Quality Assurance Project Plan)**  
**February 2014**

**Site 16/F Vapor Intrusion Groundwater Investigation**  
**Naval Weapons Station Earle**  
**Colts Neck, New Jersey**

**Prepared for:**  
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**Prepared under:**  
**Comprehensive Long-term Environmental Action Navy**  
**Contract No. N62470-08-D-1001**  
**Contract Task Order WE15**

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NAVFAC SE

"No Comment" Letter to Follow

  
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New Jersey Department of Environmental Protection

## **EXECUTIVE SUMMARY**

Tetra Tech, Inc. (Tetra Tech) has prepared this Sampling and Analysis Plan (SAP) for groundwater sampling at Site 16/F at Naval Weapons Station (NWS) Earle, Colts Neck, New Jersey. The purpose of this groundwater sampling investigation at Site 16/F is to delineate the lateral extent of the groundwater contaminant plume to determine if a vapor intrusion (VI) investigation is required in occupied buildings located near the plume.

Site 16/F consists of groundwater contamination beneath a railroad maintenance yard resulting from leaks of diesel fuel and gasoline from an underground storage tank (UST) system. The system was removed in 1995, and extensive investigations were performed between 1995 and 1997 to delineate the extent of the contamination. A focused hydrogeologic investigation and site characterization for the remedial action work plan were performed in 1997. The groundwater contamination consists of a Light Non-Aqueous Phase Liquid plume and a dissolved contaminant plume. The selected remedial action at the site is monitored natural attenuation for the dissolved contaminant plume. Remediation of the free product at Site 16/F is accomplished by means of a bioslurper system that is maintained and operated by the United States Department of the Navy (Navy).

The New Jersey Department of Environmental Protection (NJDEP) approved the remedial action and the Classification Exception Area (CEA) documents for the site in 1998. As part of the CEA, a groundwater monitoring program began in August 1998 and has proceeded on a quarterly basis since that time. The contaminants of concern for the site are benzene, toluene, ethylbenzene, xylene, and naphthalene. Sampling for methyl tert-butyl ether began during the Year 2 (2000) sampling event.

Several occupied buildings border the groundwater contaminant plume. Historical sampling results indicate dissolved benzene concentrations in excess of NJDEP screening values for VI in several site monitoring wells. The plume has not been sufficiently delineated to determine if there are volatile organic compound (VOC) exceedances within the NJDEP critical distance (guidelines) from the buildings, which would necessitate the performance of a VI investigation. Groundwater samples will be collected for VOC analysis using direct-push technology to determine if a VI investigation is necessary based on NJDEP guidelines.

This SAP outlines the organization, project management, objectives, planned activities, measurement, data acquisition, assessment, oversight, and data review procedures associated with the planned investigation. Protocols for sample collection, handling, and storage, chain of custody, laboratory and field analyses, data validation, and reporting are also addressed in this SAP. The investigation will be conducted in accordance with Tetra Tech Standard Operating Procedures, which are included in



Appendix A. Field activities conducted under this SAP will meet the requirements of the Site-Specific Health and Safety Plan, to be submitted under separate cover.

This SAP was generated for and complies with applicable United States Department of the Navy (Navy), and NJDEP requirements, regulations, guidance, and technical standards, as appropriate. This includes the Department of Defense, Department of Energy, and United States Environmental Protection Agency (EPA) Intergovernmental Data Quality Task Force environmental requirements regarding federal facilities as specified in the Uniform Federal Policy for Quality Assurance Project Plans guidance document (EPA, 2005), and revised in accordance with the Navy Tier II format.

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## ACRONYMS AND ABBREVIATIONS

°C	Degrees Celsius
%D	Percent Difference or Percent Drift
%R	Percent Recovery
B&RE	Brown and Root Environmental
bgs	Below Ground Surface
BTEX	Benzene, Toluene, Ethylbenzene, and Total Xylenes
CAS	Chemical Abstracts Service
CEA	Classification Exception Area
CLEAN	Comprehensive Long-term Environmental Action Navy
CLP	Contract Laboratory Program
COC	Contaminant of Concern
CSM	Conceptual Site Model
DL	Detection Limit
DO	Dissolved Oxygen
DoD	Department of Defense
DPT	Direct-Push Technology
DQO	Data Quality Objective
DVM	Data Validation Manager
ECOR	ECOR Solutions, Inc.
ELAP	Environmental Laboratory Accreditation Program
EPA	United States Environmental Protection Agency
EPIC	Environmental Photographic Interpretation Center
FOL	Field Operations Leader
FWEC	Foster Wheeler Environmental Corporation/Earth Tech
FTMR	Field Task Modification Request
FSPM	Field Sampling Procedures Manual
GC/MS	Gas Chromatograph/Mass Spectrometer
GPS	Global Positioning System
GWQS	Groundwater Quality Standard
H&S	H&S Environmental, Inc.
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HCl	Hydrochloric Acid
HSM	Health and Safety Manager
ICAL	Initial Calibration

## **ACRONYMS AND ABBREVIATIONS (Continued)**

IDW	Investigation-Derived Waste
IS	Internal Standard
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LNAPL	Light Non-Aqueous Phase Liquid
LOD	Limit of Detection
LOQ	Limit of Quantitation
µg/L	Microgram per Liter
mL	Milliliter
MPC	Measurement Performance Criterion
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MTBE	Methyl Tert-Butyl Ether
NAD83	North American Datum of 1983
NAVFAC	Naval Facilities Engineering Command
NAVFAC ESC	Naval Facilities Engineering Services Center
Navy	United States Department of the Navy
NEDD	NIRIS Electronic Data Deliverable
NIRIS	Naval Installation Restoration Information Solution
NJDEP	New Jersey Department of Environmental Protection
NWS	Naval Weapons Station
ORP	Oxidation-Reduction Potential
OSHA	Occupational Safety and Health Administration
PAL	Project Action Limit
PID	Photoionization Detector
PM	Project Manager
POC	Point of Contact
PPE	Personal Protective Equipment
PQLG	Project Quantitation Limit Goal
PVC	Polyvinyl Chloride
QAM	Quality Assurance Manager
QAO	Quality Assurance Officer
QC	Quality Control
QSM	Quality Systems Manual
RI	Remedial Investigation

## **ACRONYMS AND ABBREVIATIONS (Continued)**

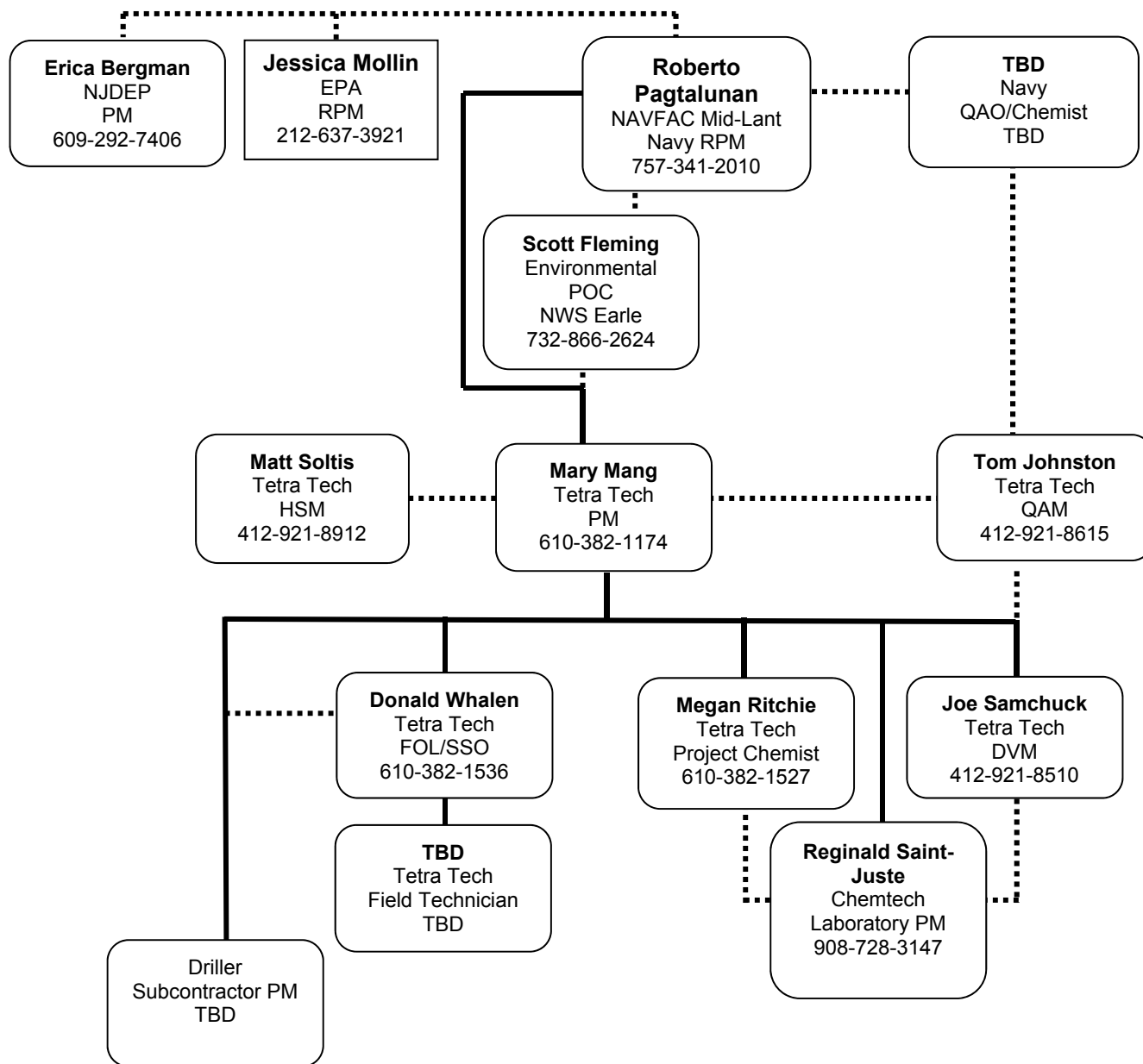
RPD	Relative Percent Difference
RPM	Remedial Project Manager
RSD	Relative Standard Deviation
RT	Retention Time
SAP	Sampling and Analysis Plan
SCAPS	Site Characterization and Analysis Penetrometer System
SOP	Standard Operating Procedure
SQL	Structured Query Language
SSO	Site Safety Officer
TBD	To Be Determined
Tetra Tech	Tetra Tech, Inc.
TPH	Total Petroleum Hydrocarbons
UFP-QAPP	Uniform Federal Policy for Quality Assurance Project Plans
UST	Underground Storage Tank
VI	Vapor Intrusion
VI GWSL	Vapor Intrusion Groundwater Screening Level
VIT Guidance	NJDEP Vapor Intrusion Technical Guidance
VOC	Volatile Organic Compound
Weston	Roy F. Weston, Inc.

## 1.0 -- Project Organizational Chart

(UFP-QAPP Manual Section 2.4.1 – Worksheet #5)

Lines of Authority —————

..... Lines of Communication



DVM - Data Validation Manager  
 EPA – U.S. Environmental Protection Agency  
 NJDEP - New Jersey Department of Environmental Protection  
 NWS – Naval Weapons Station  
 FOL - Field Operation Leader  
 HSM - Health and Safety Manager  
 NAVFAC - Naval Facilities Engineering Command  
 PM - Project Manager

POC - Point of Contact  
 QAM - Quality Assurance Manager  
 QAO - Quality Assurance Officer  
 RPM - Remedial Project Manager  
 SSO - Site Safety Officer  
 TBD - To Be Determined

## 2.0 -- Communication Pathways

(UFP-QAPP Manual Section 2.4.2 – Worksheet #6)

The communication pathways for the Sampling and Analysis Plan (SAP) are shown below.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Regulatory Agency Interface	NJDEP RPM Navy RPM	Erica Bergman Roberto Pagtalunan	609-292-7406 757-341-2010	The Navy RPM will contact each regulatory agency via phone and/or e-mail within 24 hours of recognizing the issue whenever issues arise.
Field Progress Reports	Tetra Tech FOL Tetra Tech PM	Donald Whalen Mary Mang	610-382-1536 610-382-1174	The Tetra Tech FOL will contact the Tetra Tech PM on a daily basis via phone, and every 1-2 days summarizing progress via e-mail.
Gaining Site Access	Tetra Tech FOL NWS Earle POC	Donald Whalen Scott Fleming	610-382-1536 732-866-2624	The Tetra Tech FOL shall contact the NWS Earle POC verbally or via e-mail at least 3 days prior to commencement of field work to arrange for access to the site for all field personnel.
Obtaining Utility Clearances	Tetra Tech FOL	Donald Whalen	610-382-1536	The Tetra Tech FOL shall contact the NJDEP One Call system verbally or via e-mail at least 3 days prior to commencement of field work to complete a utility clearance ticket for the areas under investigation. The FOL will also coordinate with the Base to identify utilities.
Stop Work due to Safety Issues	Tetra Tech SSO Tetra Tech PM Tetra Tech HSM Navy RPM  NWS Earle POC	Donald Whalen Mary Mang Matt Soltis Roberto Pagtalunan Scott Fleming	610-382-1536 610-382-1174 412-921-8912 757-341-2010  732-866-2624	If Tetra Tech is the responsible party for a stop work command, the Tetra Tech SSO will inform on-site personnel, subcontractor(s), the NWS Earle POC, and the identified Project Team members within 1 hour (verbally or by e-mail). If a subcontractor is the responsible party, the subcontractor PM must inform the Tetra Tech SSO within 15 minutes verbally, and the Tetra Tech SSO will then follow the procedure listed above.
SAP Changes Prior to Field/ Laboratory Work	Tetra Tech FOL/SSO Tetra Tech PM Navy RPM  NWS Earle POC	Donald Whalen Mary Mang Roberto Pagtalunan Scott Fleming	610-382-1536 610-382-1174 757-341-2010  732-866-2624	The Tetra Tech PM will document the proposed changes via a Field Task Modification Request (FTMR) form within 5 days and send the Navy RPM a concurrence letter within 7 days of identifying the need for change if necessary. SAP amendments will be submitted by the Tetra Tech PM to the Navy RPM for review and approval. The Tetra Tech PM will send scope changes to the Project Team via e-mail within 1 business day.



**Project-Specific SAP**  
**Site Name/Project Name:** NWS Earle  
**Site Location:** Colts Neck, New Jersey

**Title:** SAP for Site 16/F Vapor Intrusion Groundwater Investigation  
**Revision Number:** 0  
**Revision Date:** February 2014

<b>Communication Drivers</b>	<b>Responsible Entity</b>	<b>Name</b>	<b>Phone Number</b>	<b>Procedure (Timing, Pathway To/From, etc.)</b>
SAP Changes in the Field	Tetra Tech FOL/SSO Tetra Tech PM Navy RPM  NWS Earle POC	Donald Whalen Mary Mang Roberto Pagtalunan Scott Fleming	610-382-1536 610-382-1174 757-341-2010  732-866-2624	The Tetra Tech FOL will verbally inform the Tetra Tech PM on the day that the issue is discovered.  The Tetra Tech PM will inform the Navy RPM and the NWS Earle POC (verbally or via e-mail) within 1 business day of discovery.  The Navy RPM will issue a scope change (verbally or via e-mail), if warranted. The scope change is to be implemented before further work is executed.  The Tetra Tech PM will document the change via an FTMR form within 2 days of identifying the need for change and will obtain required written approvals within 5 days of initiating the form.
Field Corrective Actions	Tetra Tech PM Tetra Tech QAM Navy RPM	Mary Mang Tom Johnston Roberto Pagtalunan	610-382-1174 412-921-8615 757-341-2010	The Tetra Tech QAM will notify the Tetra Tech PM verbally or by e-mail within one business day that the corrective action has been completed.  The Tetra Tech PM will then notify the Navy RPM (verbally or by e-mail) within 1 business day.
Sample Receipt Variances	Chemtech PM  Tetra Tech FOL Tetra Tech PM	Reginald Saint-Juste Donald Whalen Mary Mang	908-728-3147  610-382-1536 610-382-1174	The Laboratory PM will notify (verbally or via e-mail) the Tetra Tech FOL immediately upon receipt of any chain of custody/sample receipt variances for clarification or direction from the Tetra Tech FOL.  The Tetra Tech FOL will notify (verbally or via e-mail) the Tetra Tech PM within 1 business day, if corrective action is required.  The Tetra Tech PM will notify (verbally or via e-mail) the Laboratory PM and the Tetra Tech FOL within 1 business day of any required corrective action.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Reporting Laboratory Quality Variances	Chemtech PM Tetra Tech Project Chemist Tetra Tech PM Tetra Tech FOL Chemtech QA/QC Director	Reginald Saint-Juste Megan Ritchie  Mary Mang Donald Whalen Himanshu Prajapati	908-728-3147  610-382-1527  610-382-1174 610-382-1536 908-728-3152	Any planned Standard Operating Procedure (SOP) variances from the quality elements specified in the Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 4.2 (October 2010) are identified in Section 10.0.  The Laboratory PM will notify (verbally or via e-mail) the Tetra Tech Project Chemist of any variance from the quality limits identified in this SAP on the day that the variance becomes known.  The Tetra Tech Project Chemist will notify (verbally or via e-mail) the Tetra Tech PM within 1 business day of the need for corrective action, if the variance is a significant issue.  The Tetra Tech PM will notify (verbally or via e-mail) the Laboratory PM and the Tetra Tech FOL and Project Chemist within 1 business day of any required corrective action.  The Laboratory QAM will document all quality variances in the Case Narrative of the Analytical Laboratory Report.
Reporting Concerns Involving Laboratory	Tetra Tech Project Chemist Tetra Tech PM Tetra Tech FOL Chemtech PM	Megan Ritchie  Mary Mang Donald Whalen Reginald Saint-Juste	610-382-1527  610-382-1174 610-382-1536 908-728-3147	If reported analytical results are inconsistent with the planned details identified in this SAP, the Tetra Tech Project Chemist will notify (verbally or via e-mail) the Tetra Tech PM within 1 business day of identifying a concern to determine if corrective action is needed. The Tetra Tech PM will notify (verbally or via e-mail) the Laboratory PM and the Tetra Tech FOL and Project Chemist within 1 business day of any required corrective action.  If the Tetra Tech PM determines that there are significant failures or the data is not of the quality required to meet the project needs, the Tetra Tech PM will advise the Navy RPM verbally or via e-mail within 24 hours of making the determination that a significant laboratory quality deficiency has been detected that could affect this project and/or other projects. The Navy RPM will take corrective action appropriate for the identified deficiency, which may include a consult with the Navy Chemist.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Notification of Non-Usable Data	Chemtech PM  Tetra Tech Project Chemist Tetra Tech DVM Tetra Tech PM	Reginald Saint-Juste Megan Ritchie Joseph Samchuck Mary Mang	908-728-3147  610-382-1527 412-921-8510 610-382-1174	<p>If the laboratory determines that any data they have generated is non-usable, the Laboratory PM will notify (verbally or via e-mail) the Tetra Tech Project Chemist within 1 business day of when the issue is discovered.</p> <p>The Tetra Tech Project Chemist will notify (verbally or via e-mail) the Tetra Tech DVM and the Tetra Tech PM within 1 business day of the need for corrective action, if the non-usable data is a significant issue (i.e., critical sample data). Corrective action may include resampling and/or reanalyzing the affected samples.</p> <p>If a Tetra Tech Data Validator identifies non-usable data during the data validation process, the Tetra Tech DVM will notify the Tetra Tech PM verbally or via e-mail within 48 hours of validation completion that a non-routine and significant laboratory quality deficiency has resulted in non-usable data.</p> <p>The Tetra Tech PM will take corrective action appropriate for the identified deficiency to ensure the project objectives are met.</p>
Analytical Corrective Actions and Reporting Data Validation Issues	Chemtech PM Tetra Tech Project Chemist Tetra Tech DVM Tetra Tech PM Navy RPM	Reginald Saint-Juste Megan Ritchie  Joseph Samchuck Mary Mang Roberto Pagtalunan	908-728-3147  610-382-1527  412-921-8510 610-382-1174 757-341-2010	<p>The Laboratory PM will notify (verbally or via e-mail) the Tetra Tech Project Chemist within 1 business day of when an issue related to laboratory data is discovered.</p> <p>The Tetra Tech Project Chemist will notify (verbally or via e-mail) the DVM and the Tetra Tech PM within 1 business day.</p> <p>Tetra Tech DVM or Project Chemist will notify the Tetra Tech PM verbally or via e-mail within 48 hours of validation completion that a non-routine and significant laboratory quality deficiency has been detected that could affect this project and/or other projects. The Tetra Tech PM will verbally advise the Navy RPM within 24 hours of notification from the Tetra Tech DVM or Project Chemist. The Navy RPM will take corrective action appropriate for the identified deficiency. Examples of significant laboratory deficiencies include data reported that has a corresponding failed tune or initial calibration verification. Corrective actions may include a consult with the Navy Chemist.</p>

**Project-Specific SAP**  
**Site Name/Project Name:** NWS Earle  
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<b>Communication Drivers</b>	<b>Responsible Entity</b>	<b>Name</b>	<b>Phone Number</b>	<b>Procedure (Timing, Pathway To/From, etc.)</b>
Data Validation Corrective Actions	Tetra Tech DVM Tetra Tech PM	Joseph Samchuck Mary Mang	412-921-8510 610-382-1174	See "Notification of Non-Usable Data" procedure above. If a Tetra Tech Data Validator identifies non-usable data during the data validation process that requires corrective action, the Tetra Tech PM will coordinate with the Tetra Tech DVM to take corrective action appropriate for the identified deficiency to ensure the project objectives are met. Corrective action may include resampling and/or reanalyzing the affected samples, as determined by the Tetra Tech PM.

### 3.0 -- Project Planning Session Participants Sheet

(UFP-QAPP Manual Section 2.5.1 – Worksheet #9)

<b>Project Name:</b> Site 16/F Vapor Intrusion Groundwater Investigation  <b>Projected Date(s) of Sampling:</b> <u>Summer 2012</u>  <b>Project Manager:</b> <u>Mary Mang</u>			<b>Site Name:</b> <u>Site 16/F</u>  <b>Site Location:</b> <u>NWS Earle</u>		
<b>Date of Session:</b> 09/28/11 <b>Scoping Session Purpose:</b> Determine project scope.					
Name	Title	Affiliation	Phone #	E-Mail Address	Project Role
Mary Mang	PM	Tetra Tech	610-382-1174	mary.mang@tetrattech.com	Management
Roberto Pagtalunan	Navy RPM	Navy	757-341-2010	roberto.pagtalunan@navy.mil	Management
Erica Bergman	PM	NJDEP	609-292-7406	erica.bergman@dep.state.nj.us	Regulatory
Jessica Mollin	RPM	EPA Region 2	212-637-3921	mollin.jessica@epa.gov	Regulatory
Donald Whalen	Geologist	Tetra Tech	610-382-1536	don.whalen@tetrattech.com	FOL/SSO

Comments/Decisions: NJDEP requested that the Navy develop a work plan to investigate the lateral extent of the groundwater plume at Site 16/F to determine if a vapor intrusion (VI) investigation is needed for the buildings near the site.

Action Items: Develop SAP.

<b>Project Name:</b> Site 16/F Vapor Intrusion Groundwater Investigation  <b>Projected Date(s) of Sampling:</b> <u>Summer 2012</u>  <b>Project Manager:</b> <u>Mary Mang</u>			<b>Site Name:</b> <u>Site 16/F</u>  <b>Site Location:</b> : <u>NWS Earle</u>		
<b>Date of Session:</b> 02/12/12 <b>Scoping Session Purpose:</b> Scoping Meeting					
Name	Title	Affiliation	Phone #	E-Mail Address	Project Role
Mary Mang	PM	Tetra Tech	610-382-1174	mary.mang@tetrattech.com	Management
Roberto Pagtalunan	Navy RPM	Navy	757-341-2010	roberto.pagtalunan@navy.mil	Management
Erica Bergman	PM	NJDEP	609-292-7406	erica.bergman@dep.state.nj.us	Regulatory
Donald Whalen	Geologist	Tetra Tech	610-382-1536	don.whalen@tetrattech.com	FOL/SSO

Comments/Decisions: Updated NJDEP VI guidance document issued in January 2012 should be used for planning the scope of the investigation.

Action Items: Complete SAP and implement review process.

## **4.0 -- Conceptual Site Model**

(UFP-QAPP Manual Section 2.5.2 – Worksheet #10)

This section presents general background information about Site 16/F, including a summary of previous investigations and a Conceptual Site Model (CSM) for the site, which summarizes the information that is currently known and how this relates to the project goals and uncertainties in accordance with EPA QA/G-4 guidance (EPA, 2006).

### **4.1 SITE LOCATION**

NWS Earle is an active United States Navy facility located in Monmouth County, New Jersey (Figure 4-1). The station consists of two areas, the 10,160 acre main base (Mainside) that borders the townships of Colts Neck, Howell and Wall, and the borough of Tinton Falls, and the Waterfront facility located in the Leonardo section of Middletown Township. The two areas are connected by a 15-mile Navy controlled rail and road corridor. The total site boundary of the NWS Earle station encompasses approximately 50 miles, including the Mainside Area, controlled right-of-way, and Waterfront Area.

Site 16/F is located within the Mainside Area northwest of Building C-19, approximately 0.44 mile (2,320 feet) south of the northern Mainside Area boundary and approximately 0.45 mile (2,380 feet) east of the western Mainside Area boundary (Figure 4-1).

### **4.2 SITE DESCRIPTION AND BACKGROUND INFORMATION**

Site 16 is an approximately 8-acre active rail car maintenance and storage yard operated by the Navy, encompassing the former locations of demolished Buildings C-16, C-17, and C-20, and existing Buildings C-18, C-19, and C-50. Buildings C-17 and C-20 served as the gasoline station for the Base since at least the early 1940s. Building C-19 is the forklift maintenance and repair shop and Building C-50 is used for the maintenance and repair of locomotives and rail cars. The site was identified in 1977 when a leaking underground fuel line was discovered. The fuel line transported diesel fuel from underground storage tanks (USTs) located next to former Building C-20 to a former dispensing station located north/northwest of Building C-50. The line was excavated in 1977 and was determined to have leaked about 50 gallons of diesel fuel. The USTs adjacent to Building C-20 were also removed. A subsequent analysis of historical aerial photographs, performed for the EPA at the Environmental Monitoring Systems Laboratory in Las Vegas, Nevada (i.e., the Environmental Photographic Interpretation Center [EPIC] Study) identified two former diesel tank areas around Building C-50, an oil water separator and leach field east of Building C-50, a solvent leach field northwest of Build C-50, and a locomotive wash area north of Building C-19. This area is referred to as EPIC Site F. Since Site 16 is located within the approximate outline of EPIC Site F, the sites are collectively referred to as Site 16/F,

which includes the entire railroad maintenance yard located in the Mainside Area. The rail yard has been active since the late 1940s.

During a 1992 site investigation, hydrocarbon contamination was found in soils at Site 16/F (Weston, 1994). In 1995, the Navy conducted a Site Characterization and Analysis Penetrometer System (SCAPS) investigation using fluorescent mapping to gain a better understanding of the extent of contamination. This investigation led to the discovery of a large concentration of free-product diesel fuel on top of the shallow groundwater. The results identified two contamination hot-spots; one in the vicinity of MW16-04 (located southeast of former Building C-16), and a smaller area located north of Building C-50 (NAVFAC ESC, 1996).

In April 1995, two 13,000 gallon concrete USTs (C17/C20-1 and C17/C20-2) that had been utilized for the storage of unleaded gasoline were removed from the ground adjacent to former buildings C-17/C-20, and in July 1995, a single 10,000-gallon fiberglass UST (C17/C20-FG) that had been utilized for the storage of unleaded gasoline was removed from the same area (Enviro-Tech, 1995).

In 1996, a pilot scale bioslurper system was installed to determine whether the free-product fuel could be removed. The bioslurper system was designed to recover light non-aqueous phase liquid (LNAPL) via vacuum-enhanced pumping while remediating the vadose zone via bio-venting. The pilot study showed that LNAPL remediation was feasible. Two full-scale bioslurper units were constructed at Site 16/F. Modifications to these systems were made to address elevated iron concentrations and a large-scale system was designed, constructed, and operated beginning in February 1998. Bioslurper #1 includes both liquid and vapor phase removal. In November 2004, Bioslurper #2, centered north of Building C-50, was deactivated by the Navy due to minimal LNAPL recovery. In December 2005, an Optimization Study was conducted and five additional wells were installed, sampled, and subsequently connected to the bioslurper. As of November 2010, approximately 5,520 gallons of LNAPL had been recovered using the system.

In 1997, the NJDEP approved the Focused Investigation and Remedial Action Work Plan for Buildings C-17/20/16/50. The selected remedial method for the dissolved contaminants in the groundwater was monitored natural attenuation. Remediation of the free product at Site 16/F was addressed by means of the bioslurper system (B&RE, 1997).

In 1998, former Buildings C-16, C-17, and C-20 were demolished and five 12,000-gallon USTs were removed from the site. Four of the excavated USTs were located next to the former Building C-17 (former fuel station) and were used for storage of diesel, gasoline, and No. 2 oil fuel. The fifth UST was located near Building C-50 and had held diesel fuel (FWEC, 1999).

In 1998, the Classification Exception Area (CEA) documentation for the site was approved by NJDEP. Figure 4-2 shows the CEA boundary. As part of the CEA, a groundwater monitoring program was instituted to document the migration, degradation, and attenuation of target contaminants at the site. The monitoring program began in August 1998 and has proceeded on a quarterly basis since that time. The contaminants of concern (COCs) listed for the site are as follows: benzene, toluene, ethylbenzene, xylene (BTEX), and naphthalene (Tetra Tech, 1999). Sampling for methyl tert-butyl ether (MTBE) began during the Year 2 (2000) sampling event because of recently published health concerns about MTBE (Tetra Tech, 2000).

The bioslurper remediation system at Site 16/F addresses three areas: an LNAPL plume southeast of the former Building C-16, a smaller LNAPL plume north of Building C-50, and a dissolved phase plume from the former gas station (former Building C-17) west of building C-18.

The current network of recovery wells that are connected to Bioslurper #1 include 18 recovery wells in the main LNAPL plume centered around the southeast corner of former Building C-16 (16MW04, 16MW13 through 16MW19, 16MW25 through 16MW28, 16MW31 through 16MW35, and C17MW07) and two recovery wells located north of Building C-50 (16MW20 and 16MW21). These wells are connected to Bioslurper #1 by means of a common 2-inch polyvinyl chloride (PVC) manifold. Two vapor extraction wells, 16MW22 and 16MW23, are located west of Building C-18.

LNAPL thickness measurements are obtained from 20 extraction wells on a monthly basis as part of the bioslurper operations at the site. Table 4-1 lists the maximum LNAPL thicknesses in the recovery wells during Year 14 (August 2011 to May 2012) of the monitoring program. Figure 4-3 shows the areal distribution of the LNAPL.

**TABLE 4-1**  
**MAXIMUM LNAPL THICKNESS IN**  
**RECOVERY WELLS**  
**YEAR 14 MONITORING PROGRAM**

<b>Recovery Well</b>	<b>LNAPL Thickness (feet)</b>
16MW-04	0.23
16MW-13	0.48
16MW-14	0.26
16MW-15	0.28



**TABLE 4-1**  
**MAXIMUM LNAPL THICKNESS IN**  
**RECOVERY WELLS**  
**YEAR 14 MONITORING PROGRAM**

<b>Recovery Well</b>	<b>LNAPL Thickness (feet)</b>
16MW-16	0.33
16MW-17	0.31
16MW-18	0.01
16MW-19	0.21
16MW-20	0.21
16MW-25	0.01
16MW-27	0.24
16MW-33	0.34
16MW-34	0.13
16MW-35	0.12

### **4.3 PHYSICAL SETTING**

The following sections describe features of the physical setting of the site that are relevant to the project.

#### **4.3.1 Land Use and Surface Features**

The bulk of Site 16/F consists of an active rail car maintenance and storage yard. The area is covered by railroad tracks and paved and unpaved surfaces. The site slopes gently to the north.

#### **4.3.2 Geology**

The site is in the Atlantic Coastal Plain physiographic province. The Coastal Plain is underlain by a wedge of unconsolidated sediments of Quaternary and Cretaceous age that thicken to the southeast. The sediments overlie crystalline bedrock of early Paleozoic age.

Regional maps indicate that Site 16/F is within the outcrop area of the Vincentown Formation and upper colluvium. The Vincentown Formation is described as a gray and green fine- to course-grained

glauconitic sand with silt, and the upper colluvium consists of a shallow massive sand and silty sand (B&RE, 1996a). Data from boring logs and the SCAPS investigation indicate that fine- to medium-grained sand and sandy silt soils underlie the site (NAVFAC ESC, 1996).

#### **4.3.3      Hydrogeology**

Shallow groundwater at the site occurs within the unconfined aquifer composed of the sandy elements of the Vincentown Formation and the overlying upper colluvium and fill materials, where saturated. The depth to groundwater throughout the site ranges from approximately 5 to 10 feet below ground surface (bgs). Slug testing conducted during the 1995 Remedial Investigation (RI) field activities indicated that hydraulic conductivity at the site is approximately 1 foot per day (B&RE, 1997). Based on water table elevation measurements taken during the RI and annual sampling events, groundwater beneath the site flows to the north.

There are 18 monitoring wells at Site 16/F (18MW01, 16MW02, 16MW04, 16MW05 through 16MW12, 16MW15, 16MW16, 16MW17, 16MW24, 16MW25, 16MW36, and 17MW17) in addition to the 20 recovery wells previously described. Figure 4-2 shows the monitoring well and recovery well locations.

#### **4.4              SUMMARY OF PREVIOUS INVESTIGATIONS**

The following is a summary of the previous investigations performed at the site.

##### **Site Investigation Report**

The site investigation of Site 16/F was performed in 1992. Five subsurface soil samples were collected in the area north of Building C-18, the reported location of the underground fuel line leak. All the samples contained elevated levels of total petroleum hydrocarbons (TPH) and low levels of semivolatile organic compounds (Weston, 1994).

##### **UST Closure Report**

In 1995, as a part of a facility-wide upgrade of the UST systems and failures of tightness testing at certain USTs, the Navy closed three USTs at former Buildings C-17/C-20, which were utilized for storage of unleaded gasoline. The results of post-excavation soil sampling indicated that benzene, ethylbenzene, and total xylene remained in the ground in the vicinity of the excavated USTs at levels above NJDEP soil cleanup criteria. The exception was one UST located southeast of former Building C-20 (Site 16/F), which had no detected soil contamination above NJDEP soil cleanup criteria (Enviro-Tech, 1995).

## **Remedial Investigation**

The Site 16/F RI, conducted between June and October 1995 by Brown and Root Environmental (B&RE), included a soil gas survey, the collection of surface and subsurface soil and sediment samples, and the installation and sampling of six monitoring wells. The investigation found hydrocarbon contamination in subsurface soils and groundwater. The groundwater contamination was associated with a layer of LNAPL (B&RE, 1996a).

## **SCAPS Survey**

In 1995, the Navy conducted a survey at Site 16/F using the SCAPS field technology. The fluorescent mapping obtained from the SCAPS effort was used to gain a better understanding of the subsurface contaminant distribution. Twenty SCAPS borings were completed in the area between former Building C-16 and Building C-50. The SCAPS results identified two contamination hot spots; one in the vicinity of monitoring well 16MW-04 located southeast of former Building C-16, and a second smaller hot spot located northeast of Building C-50 (NAVFAC ESC, 1996).

## **UST Remedial Investigation Report for Various Sites**

From 1995 to early 1996, a site-wide investigation of USTs, including those located at Site 16/F, was conducted at NWS Earle. Soil gas surveys, direct-push technology (DPT) soil borings and soil sampling, and groundwater sampling were performed to identify areas of potential soil and groundwater contamination. Soil and groundwater within the vicinity and downgradient of Site 16/F exhibited petroleum-related compounds at levels in excess of NJDEP residential direct contact soil cleanup criteria and Ground Water Quality Standards (GWQS). Soil contamination in excess of NJDEP cleanup criteria was found within the subsurface at the dispensing station in the vicinity of the abandoned diesel supply pipe leading to Building C-50. A floating layer of free product diesel fuel was detected at the soil-groundwater interface, and dissolved volatile organic compounds (VOCs) were detected in groundwater. Corrective actions were recommended to address free product removal from the groundwater and vadose zone within the area north and northeast of former Buildings C-17/C-20 and to address soil contamination remaining in the vicinity of the former concrete tanks and piping systems within the vicinity of former Building C-20. The absence of groundwater receptors supported consideration of intrinsic bioremediation or natural attenuation of the dissolved VOCs in groundwater (B&RE, 1996b).

## **UST Closure Report**

In December 1998, five 12,000 gallon USTs were removed from Site 16/F. Four of the excavated USTs were located near former Building C-17 (former dispensing station) and were used for diesel, gasoline, and No. 2 fuel oil storage. The fifth, a diesel fuel UST, was located by Building C-50 (Diesel Locomotive Shop). Post-excavation soil samples indicated no exceedances of TPH at Building C-50. Exceedances of NJDEP Soil Cleanup Criteria for TPH and total xylenes were observed in confirmatory soil samples collected at former Building C-17 (FWEC, 1999).

## **Groundwater Monitoring Program**

The results of the Site 16/F groundwater monitoring program during each year (Years 1 through 13) are summarized below. Tetra Tech generated the groundwater monitoring reports for Years 1 through 6, ECOR Solutions, Inc. (ECOR) for Years 7 through 11, and H&S Environmental, Inc. (H&S) for Years 12 and 13.

### Year 1 Monitoring Program (August 1998 - May 1999)

The Year 1 monitoring program included the following monitoring wells: 16MW02, 16MW03, 16MW04, 16MW05, 16MW06, 16MW08, 16MW10, 17MW01, 17MW02, and 18MW01. In 16MW06, benzene exceeded the GWQS [1 microgram per liter ( $\mu\text{g/L}$ )] in all four sampling periods. Benzene exceeded the GWQS for at least one event in monitoring wells 16MW08, 16MW03, and 16MW05 (Tetra Tech, 1999).

### Year 2 Monitoring Program (August 1999 - May 2000)

The Navy modified the monitoring program for Year 2 to include monitoring well 16MW09, located approximately 125 feet north and down gradient from monitoring well 16MW06. Benzene exceeded the GWQS in all four sampling periods at monitoring well 16MW06, and in three sampling periods at monitoring well 16MW09 (Tetra Tech, 2000).

### Year 3 Monitoring Program (August 2000 - May 2001)

The Navy modified the monitoring program to include an additional downgradient monitoring well (16MW11) located approximately 280 feet north and downgradient of monitoring well 16MW09. Benzene concentrations exceeded the GWQS for at least one sampling event in wells 16MW08, 16MW09, 16MW10, 16MW11, and 17MW02 (Tetra Tech, 2001).

#### Year 4 Monitoring Program (August 2001 - May 2002)

MTBE exceeded the GWQS (70 µg/L) in at least one sampling period in monitoring wells 16MW05 and 16MW11. Benzene exceeded the GWQS in 6 of 7 downgradient monitoring wells. At monitoring well 16MW05, located in the area of LNAPL, benzene exceeded the GWQS at concentrations ranging from 180 µg/L in August 2001 to 2,500 µg/L in November 2001. As a result of additional investigations in the area of monitoring well 16MW-11, the Navy added five new downgradient monitoring wells, 16MW15, 16MW16, 16MW17, 16MW24, 16MW25, and two surface water sampling locations, 16SW01 and 16SW02, to the long-term monitoring program for the site (Tetra Tech, 2002).

#### Year 5 Monitoring Program (August 2002 - May 2003)

MTBE concentrations exceeded the GWQS in November 2002 and February 2003 at monitoring well 16MW11. Benzene exceeded the GWQS in nine monitoring wells. The highest benzene concentration (132 µg/L) was observed in monitoring well 16MW11 during the February 2003 sampling period. Within the CEA-delineated area, benzene exceeded the GWQS at monitoring well 16MW05 during two sampling periods when LNAPL was not present. Samples were not collected when LNAPL was present. Naphthalene levels exceeded the GWQS (300 µg/L) in monitoring well 16MW05 during the August 2002 sampling period (Tetra Tech, 2003).

#### Year 6 Monitoring Program (August 2003 - May 2004)

Monitoring wells 16MW02, 16MW06, and 16MW16 were removed from the monitoring program after the second quarter. Monitoring well 16MW03 was closed and was replaced by monitoring well 17MW02 in the program. The naphthalene analysis was omitted for the following six wells and both surface water locations: 16MW03 (not currently sampled), 16MW09 (not currently sampled), 16MW15, 16MW17 (not currently sampled), 16MW24, 16MW25, 16SW01, and 16SW02. MTBE concentrations exceeded the GWQS during one sampling event in monitoring well 16MW05, which was only sampled once due to the presence of LNAPL, and during three sampling events at monitoring well 16MW11. Benzene concentrations exceeded the GWQS in eight monitoring wells during at least one sampling period. The highest benzene concentration (2,230 µg/L) was detected in monitoring well 16MW05 during the November 2003 sampling event. Benzene concentrations exceeded the GWQS during all sampling events in monitoring wells 16MW11 and 16MW15 (Tetra Tech, 2004).

#### Year 7 Monitoring Program (August 2004 - May 2005)

During Year 7, monitoring well 17MW02 was renamed "16MW12" and monitoring well 17MW01 was renamed "17MW17." LNAPL was detected in monitoring well 16MW05 during three of the four sampling events at thicknesses ranging from 0.05 to 0.16 foot. A groundwater sample was collected during November 2004 when LNAPL was not present and MTBE was the only constituent detected that exceeded the GWQS (ECOR, 2005).

#### Year 8 Monitoring Program (August 2005 - May 2006)

Monitoring well 16MW09 was discontinued from the monitoring program. Five additional recovery wells were installed (16MW31, 16MW32, 16MW33, 16MW34, and 16MW35) in accordance with the Bioslurper Upgrade Work Plan (ECOR, 2005), and all were added to the LNAPL recovery remedial program. All additional recovery wells had some level of LNAPL present. Four of the five wells reached a historical maximum product thickness during Year 8, ranging from 0.07 foot in 16MW31 to 6.55 feet in 16MW33 in January 2006. Recovery well 16MW34 reached a historical maximum product thickness of 1.36 feet in March 2006 (ECOR, 2006).

#### Year 9 Monitoring Program (August 2006-May 2007)

During Year 9, LNAPL was detected in monitoring wells 16MW04 and 16MW05 during all four events ranging in thickness from 0.02 to 0.45 foot. Therefore, samples were not collected from these wells. Benzene exceeded the GWQS in all four quarters in monitoring wells 16MW08, 16MW11, and 16MW24. MTBE exceeded the GWQS in 16MW11 and 16MW24 (ECOR, 2007).

#### Year 10 Monitoring Program (August 2007-May 2008)

Monitoring wells 16MW04 and 16MW05 were not sampled during Year 10 since LNAPL was detected in these wells during all four events. Benzene exceeded the GWQS in monitoring wells 16MW08, 16MW11, and 16MW15 during all four quarters, and in 16MW24 during three quarters. MTBE exceeded the GWQS in 16MW11 during all four quarters (ECOR, 2008).

#### Year 11 Monitoring Program (August 2008-May 2009)

Monitoring wells 16MW04 and 16MW05 were not sampled during Year 11 since LNAPL was detected in these wells during all four events. Benzene exceeded the GWQS in monitoring wells 16MW08, 16MW11, and 16MW15 during all four quarters and MTBE 16MW11 exceeded the MTBE GWQS in 16MW11 during

all four quarters. The remaining wells (16MW10, 16MW24, 16MW25, and 18MW01) and surface water samples (16SW01 and 16SW02) did not exceed the GWQS for any COC (ECOR, 2009).

#### Year 12 Monitoring Program (August 2009-May 2010)

Benzene exceeded the GWQS in three monitoring wells (16MW08, 16MW11, and 16MW15) during all four sampling quarters and in 16MW10 during the August 2009 and February 2010 monitoring events. The highest benzene level (39.1 µg/L) was detected in monitoring well 16MW08 during the February 2010 sampling event. 16MW04 and 16MW05 were not sampled because LNAPL was present in both wells during all four quarters (H&S, 2010).

#### Year 13 Monitoring Program (August 2010-May 2011)

One additional monitoring well, 16MW36, was installed and added to the monitoring program. Benzene exceeded its GWQS in three monitoring wells, 16MW08, 16MW11, and 16MW15. The highest benzene concentration, 61.1 µg/L, was detected in 16MW11 during the May 2011 sampling event (H&S, 2011).

### **4.5 CONCEPTUAL SITE MODEL**

A complete or potentially complete exposure pathway includes the following components: 1) source (e.g., locations where contaminants are expected to be found); 2) an exposure medium (e.g., surface soil); 3) an exposure route (e.g., dermal contact); and 4) receptors (e.g., Navy personnel, construction workers, recreational users, authorized visitors). If the point of exposure is not at the same location as the source, the pathway may also include a release mechanism (e.g., erosion) and a transport medium (e.g., surface water). A complete pathway represents a potential for environmental contaminants to present an unacceptable human health or environmental risk. The model that follows describes current site characteristics and potential receptors in a way that was used to identify potentially complete exposure pathways and hence opportunities for unacceptable levels of risk.

Groundwater contamination is present at the site due to leaks from a UST system. The tanks contained both diesel and unleaded gasoline. The contamination consists of LNAPL and a dissolved plume of BTEX, MTBE, and naphthalene. There are two areas of LNAPL: an area north of Building C-18, which is suspected to be the result of the leaking underground diesel fuel line, and a smaller area north of Building C-50, which is suspected to be the result of minor spills at a former diesel dispensing station located between the railroad tracks north of Building C-50. Although there is no free phase product present at the former gas station area, groundwater analytical results indicate the presence of residual gasoline contamination.

There is no human exposure to groundwater because there is no access to groundwater at the site other than the monitoring wells and access to these wells is restricted. Future exposure to groundwater as drinking water is unlikely since the Navy has no plans to change the current land use. Potential exposure routes for humans who are engaged in activities associated with future exposure scenarios such as construction activities, include dermal adsorption, inhalation, or ingestion. Since buildings exist in the vicinity of the groundwater contaminant plume, there is a potential for human exposure to contaminants through VI. The lateral extent of the dissolved benzene plume has not been adequately delineated near the buildings to determine if the potential for VI exists in the nearby buildings. Since the Navy has no plans to change the current site use, potential human receptors are limited to Navy personnel, contractors, and visitors/trespassers.

Figure 4-4 shows a CSM schematic and Figure 4-5 shows the Exposure Pathway Analysis for the site.



## **5.0 -- Data Quality Objectives/Systematic Planning Process Statements**

**(UFP-QAPP Manual Section 2.6.1 – Worksheet #11)**

The following text describes the development of Data Quality Objectives (DQOs) using EPA's DQO Systematic Planning Process (EPA, 2006).

### **5.1 PROBLEM STATEMENT**

#### **Problem #1:**

NJDEP requires a VI investigation for any building in which a wet basement or sump contains free product or detectable levels of VOCs. Environmental data are needed to determine whether basement sumps (if present) in Buildings C-63, S-83, C-15, C-18, C-19, and C-50 contain free product or detectable levels of VOCs so that the need to conduct a VI investigation can be evaluated.

#### **Problem #2:**

Monitoring well 16MW06 was last sampled in November 2003, and the benzene concentration (37 µg/L) only slightly exceeded the VI GWSL (20 µg/L). Environmental data are needed to determine whether VOC concentrations exceeding VI GWSLs are present in monitoring well 16MW06 so that the need to conduct a VI groundwater investigation near Buildings C-63 and S-83 can be evaluated.

#### **Problem #3:**

A VI investigation is required if a groundwater sample collected within 30 feet of a building contains a contaminant in excess of any VI groundwater screening level (VI GWSL) (NJDEP, 2012). The areal extent of the contaminant plume at Site 16/F has not been sufficiently delineated to make this determination.

Environmental data are needed to determine whether VOC concentrations exceeding the VI GWSL are present in groundwater within 30 feet of Buildings C-63, S-83, C-15, C-18, C-19, and C-50 so that the need to conduct a VI investigation can be evaluated. Analysis of the full suite of VOCs (VI GWSL list) will be conducted for at least one round to compare to VI GWSLs since a recent analysis of VOCs has not been completed. There is concern over the presence of other VOCs besides BTEX, MTBE, and naphthalene due to bioslurper air influent results indicating other contaminants in the VI pathway.

### **5.2 INFORMATION INPUTS**

Data that are required to resolve the problem described in Section 5.1 are as follows:

1. Chemical data: Groundwater samples must be collected for analysis of VOCs to support a determination of whether contamination is present at levels exceeding the NJDEP VI GWSL in basement standing water or sump water, in select existing monitoring wells, or in temporary wells within 30 feet of a building. Applicable sampling methods and analytical groups for each sample are presented in Section 8.4, and analytical methods are presented in Section 8.5.
2. Physical data: Field investigation parameters for groundwater consisting of pH, specific conductivity, turbidity, temperature, oxidation-reduction potential (ORP), and dissolved oxygen (DO) must be collected in the field to ensure the representativeness of groundwater samples collected.
3. Determination of the existence of free product in building sumps: The presence or absence of free product in building sumps (if present) must be determined to support a determination of whether a VI groundwater investigation is necessary at Buildings C-63, S-83, C-15, C-18, C-19, and C-50.
4. Sample location data: Sample location coordinates and depths must be measured. Horizontal coordinates may be measured with equal effectiveness using a global positioning system (GPS) or by a state-licensed surveyor. Depth intervals are best measured using a tape measure or other device with similar accuracy and precision (e.g., water level meter).
5. Project Action Limit (PAL): The sample data must be compared to the NJDEP VI GWSLs.

The selected laboratory should be able to achieve detection limits (DLs), limits of detection (LODs), and limits of quantitation (LOQs) that are low enough to measure contaminant concentrations in groundwater that are less than the project action limit (PAL) in order to conduct comparisons of site data to the screening value.

Analytical data reported by the laboratory must use the following reporting conventions: All results below the DL will be considered non-detects, and positive results reported at concentrations between the DL and LOQ will be reported with a "J" qualifier. The Project Team will accept these analytical results as usable (without additional qualification) unless quality evaluations indicate that the data quality has been compromised.

### **5.3 STUDY AREA BOUNDARIES**

Each building will be investigated for wet basements and/or sumps to determine if free product or VOC contaminants are present. If NAPL or VOC contaminants are present in the standing water or sump, then the building will be included in the indoor VI investigation and inclusion in the VI groundwater investigation is not necessary.

For the VI groundwater investigation, the horizontal study area consists of the area within 30 feet of the eastern sides of Buildings C-63 (conditional), S-83 (conditional), and C-15, and the northern sides of Buildings C-18 and C-19, as determined based on the historical results discussed below.

The groundwater of interest for this investigation is the groundwater within the uppermost 5 feet of the water table aquifer, or within 10 to 15 feet of the ground surface within the horizontal study boundaries. VOC concentrations at and near the water table depth indicated above are the most relevant for gauging VI risk. Vertical profiling of the VI pathway for six-foot clean water lens is not needed at this time. Based on a review of the boring logs which indicates that the soil beneath the site consists mainly of silty sand and because the existing monitoring wells are water table wells, the existence of a clean water lens above the plume is considered highly unlikely.

Groundwater monitoring has been performed quarterly in select monitoring wells at the site since 1998. Currently these monitoring wells consist of 16MW04, 16MW05, 16MW08, 16MW10, 16MW11, 16MW15, 16MW24, 16MW25, 18MW01, and 16MW36 (the suite of monitoring wells has changed during the course of the monitoring program). The samples are analyzed for BTEX, MTBE, and naphthalene. Benzene and MTBE are the only compounds that have exceeded their VI GWSLs at any existing site monitoring well.

Historically, benzene concentrations have exceeded the VI GWSL in eight monitoring wells: 16MW04, 16MW05, 16MW06, 16MW08, 16MW09, 16MW11, 16MW15, and 16MW24. Of these wells, 16MW04, 16MW05, 16MW06, 16MW08, and 16MW09 are located within 200 feet of buildings in the Site 16/F vicinity. Monitoring wells 16MW11 and 16MW15 are located 300 feet and 800 feet northeast and down gradient of Building C-63, respectively. Figure 5-1 shows the most recent analytical results for benzene for the site wells.

Monitoring wells 16MW04 and 16MW05 have not been sampled since August 2001 and May 2003, respectively, due to the presence of LNAPL in the wells. When last sampled, the benzene concentrations in wells 16MW04 and 16MW05 were 110J µg/L and 74.5 µg/L, respectively. Building C-15 is approximately 120 feet west of 16MW05, Building C-18 is approximately 140 feet south-southeast of 16MW04 and 16MW05, and Building C-19 is approximately 140 feet southwest of 16MW04.

Monitoring well 16MW06 was included in the monitoring program from August 1998 to November 2003. Benzene concentrations exceeded the VI GWSL in 1998, 1999, 2002, and 2003. The highest concentration, 84.4 µg/L, was detected in February 1999; the most recent concentration (November 2003) was 37 µg/L. Buildings C-63 and S-83 are approximately 150 feet west of 16MW06. There are no exceedances of VI GWSLs for nearby monitoring well 16MW09, which is located

approximately 140 feet west of Building C-63. Therefore, a preliminary groundwater sample from 16MW06 will be collected for VOCs prior to the VI groundwater investigation. If any VOC results exceed the VI GWSLs, then a VI groundwater investigation within 30 feet of Buildings C-63 and S-83 will be conducted. Otherwise, Buildings C-63 and S-83 will not be included in the VI investigation.

Monitoring well 16MW08 has been included in the monitoring program since August 1998. Benzene concentrations exceeded the VI GWSL in 1999, 2000, 2001, 2003, 2004, 2005, 2006, 2007, 2008, and 2010. The highest concentration, 110 µg/L, was detected in August 2007; the most recent concentration (May 2011) was 3.4 µg/L. The nearest building, S-83, is approximately 240 feet northwest of 16MW08.

Monitoring well 16MW11 has been part of the monitoring program since August 2000, and has exceeded the benzene VI GWSL for most of that time. The most recent benzene concentration (May 2011) was 61.1 µg/L. The nearest building, C-63, is approximately 320 feet southwest of 16MW11.

Based on the locations of wells with historical VI GWSL exceedances, the buildings potentially impacted by benzene VI are Building C-63 (located approximately 140 feet west of 16MW09), Building S-83 (located approximately 150 feet west of 16MW06), Building C-15 (located approximately 120 feet west of 16MW05 and 220 feet west of 16MW04), Building C-18 (approximately 140 feet south/southeast of 16MW04 and 16MW05), Building C-19 (approximately 140 feet southeast of 16MW04), and Building C-50 (approximately 200 feet southeast of 16MW04).

## **5.4 ANALYTIC APPROACH**

To resolve the problem statement presented in Section 5.1, the following decision rule will be used:

### **Decision Rules**

1. If a wet basement or sump in a building contains free product, or VOCs are detected in a sample of standing or sump water; then recommend the building for inclusion in the indoor VI investigation; otherwise, the building will first be included in the VI groundwater investigation.
2. If any measured VOC concentration in a preliminary groundwater sample from location 16MW06 is greater than PALs, then include Buildings C-63 and S-83 in the VI groundwater investigation, otherwise, Buildings C-63 and S-83 will not be included in the VI groundwater investigation.
3. If all measured groundwater VOC concentrations 30 feet from a given building are less than the VI GWSLs, then recommend no VI investigation. If the contaminant concentration 30 feet from a given building is greater than the VI GWSL, but less than three times the VI GWSL, then collect two

confirmation samples evenly spaced temporally within 60 days of the initial sampling event. If the average of the three concentrations is less than the VI GWSL, then recommend no VI investigation; otherwise, conclude that a VI investigation is required for that building. (Note: Use the analytical reporting limit when averaging non-detect results.) If the groundwater VOC concentration 30 feet from a given building is greater than three times the VI GWSL, then conclude that a VI investigation is required for that building.

## **5.5 PERFORMANCE CRITERIA**

The only performance criterion applicable to this project is a need to collect all planned data with no significant quality deficiencies. If this is achieved, the data collected will be considered sufficient to support the decision. To evaluate data quality, the processes and criteria described in Section 12.0 will be used. Data quality deficiencies must be brought to the attention of all Project Team members for their consideration as to how the deficiencies affect attainment of project objectives (see also Section 5.4).

If all data are collected as planned and no data points are missing or rejected for quality reasons, then the investigation completeness will be considered satisfactory. If any data gaps are identified, including missing or rejected data, the Project Team will assess whether a claim of having obtained project objectives is reasonable based on the quantity and types of data gaps. All Project Team members will be involved in rendering the final conclusion by consensus regarding adequacy of the data.

## **5.6 SAMPLING DESIGN AND RATIONALE**

The plans for obtaining data along with the sampling designs and rationales are described in detail in Sections 7 and 8.

## 6.0 -- Field Quality Control Samples

(UFP-QAPP Manual Section 2.6.2 – Worksheet #12)

Quality Control (QC) Sample	Analytical Group	Frequency	Data Quality Indicators	Measurement Performance Criteria (MPCs)	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Equipment Rinsate Blank	VOC	One per 20 samples per matrix per sampling equipment <sup>(1)</sup> .	Bias/ Contamination	No analytes $\geq \frac{1}{2}$ LOQ.	S & A
Trip Blank	VOC	One per cooler containing VOC samples.	Bias/ Contamination	No analytes $\geq \frac{1}{2}$ LOQ.	S & A
Field Duplicate	VOC	One per 10 field samples.	Precision	Values > 5X LOQ: Relative Percent Difference (RPD) must be $\leq 30$ (aqueous) <sup>(2)</sup> .	S & A
Cooler Temperature Indicator	VOC	One per cooler.	Representativeness	Temperature must be above freezing and less than or equal to 6 degrees Celsius ( $^{\circ}\text{C}$ ).	S

Notes:

<sup>(1)</sup> Equipment rinsate blanks will be collected if non-dedicated submersible pumps or other equipment are used.

<sup>(2)</sup> If duplicate values for non-metals are less than five times the LOQ, the absolute difference should be less than or equal to two times the LOQ.

## **7.0 -- Sampling Design and Rationale**

(UFP-QAPP Manual Section 3.1.1 – Worksheet #17)

### **Sample Location Rationale**

The selected sampling design is a judgmental design based on selecting temporary well locations to target the groundwater population of interest. A maximum of seven temporary wells will be installed using DPT at the locations shown on Figure 7-1. The proposed temporary well locations are based on existing monitoring well sample results and on the need to determine VOC concentrations in the shallow aquifer near buildings. Temporary wells will be installed on the side of the building that faces in the direction of the contaminant plume, 30 feet from the building. One temporary well will be installed at each of Buildings C-18, C-19, and C-50. One temporary well will be installed at each of Buildings C-63 and S-83 if the groundwater sample results for 16MW06 indicate the presence of VOCs at concentrations exceeding VI GWSLs. Two temporary wells will be installed at Building C-15 due to its larger size. At least one groundwater sample will be collected from each temporary well. If a temporary well contains a contaminant concentration that exceeds the VI GWSL, but is less than three times the VI GWSL, then the temporary well will be resampled two additional times evenly spaced temporally within 60 days of the initial sampling event.

A groundwater sample will be collected from the water in any basement sump in Buildings C-63, S-83, C-15, C-18, C-19, and C-50 for VOC analysis.

A list of samples to be collected is provided in Section 8.5.

The coordinates of each temporary well location will be determined by a New Jersey-licensed surveyor, which will allow for future repeatable investigations.

### **Media and Analyses Rationale**

The groundwater samples will be analyzed for the full suite of VOCs. Historically, benzene and MTBE are the only COCs that exceed VI GWSL; however, any exceedance of VI GWSLs determines inclusion of a COC. There is concern over the presence of other VOCs besides BTEX, MTBE, and naphthalene due to bioslurper air influent results indicating other contaminants in the VI pathway.

Samples will be submitted to Chemtech for chemical analysis of VOCs. The analytical method and laboratory SOP are identified in Section 10.0. The total number of sample analyses for each target analyte or analytical group are identified in Section 8.6. Section 8.5 presents a summary of the sample

analyses, container types and volumes, preservation requirements, and holding times for the samples to be collected.

Field QC samples will be collected as part of the investigation, including field duplicates, equipment rinsate blanks, and trip blanks. Section 8.6 presents the field QC sample summary. Also, additional sample volume will be collected as necessary for laboratory QC analysis of matrix spike (MS) and matrix spike duplicate (MSD) samples.



## **8.0 -- Field Project Implementation (Field Project Instructions)**

(UFP-QAPP Manual Section 5.2.3 – Worksheets #14, 18, 19, 20, 21, and 30)

### **8.1 FIELD PROJECT TASKS**

(UFP-QAPP Manual Section 2.8.1 – Worksheet #14)

Project-specific SOPs for field tasks identified in this section are provided in Appendix A, and these tasks are described briefly below. The field tasks are as follows:

- Mobilization/Demobilization
- Site-Specific Health and Safety Training
- Utility Clearance
- Monitoring Equipment Calibration
- Sample Collection and Sample Handling Tasks
- Permanent Monitoring Well Sampling
- Temporary Well Sampling
- Basement Sump Sampling
- Surveying
- Investigation-Derived Waste (IDW) Management
- Field Decontamination Procedures
- Field Documentation Procedures
- Quality Control Tasks

The field tasks are summarized below.

#### **Mobilization/Demobilization**

Mobilization shall consist of the delivery of all equipment, materials, and supplies to the site; the complete assembly in satisfactory working order of all such equipment at the site; and the satisfactory storage at the site of all such materials and supplies. Site-specific Health and Safety Training for all Tetra Tech field subcontractors will be provided as part of the site mobilization.

Demobilization shall consist of the prompt and timely removal of all equipment, materials, and supplies from the site following completion of the work. Demobilization includes the cleanup and removal of waste generated during the conduct of the investigation.

### **Site-Specific Health and Safety Training**

There are no specialized/non-routine project-specific training requirements or certifications needed by personnel to successfully complete the project or tasks. All field personnel will have appropriate training to conduct the field activities to which they are assigned. Each site worker will be required to have completed the Occupational Safety and Health Administration (OSHA) 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) course (and 8-hour refresher, if applicable). Safety requirements are addressed in greater detail in the site-specific Health and Safety Plan (HASP).

### **Utility Clearance**

Prior to the commencement of any intrusive activities, Tetra Tech will subcontract a local firm to identify and mark-out utilities that may be present within the proposed drilling areas. Tetra Tech will meet the subcontractor in the field to identify the proposed drilling locations. Copies of any site plans or drawings that may have been provided to Tetra Tech by the facility will be made available to the utility locating subcontractor for review and use. Subsurface utilities will also be cleared by the excavation subcontractor by notifying the New Jersey One-Call utility clearing service. See Tetra Tech SOP HS-1.0 (Appendix A) for further information on utility clearance.

### **Monitoring Equipment Calibration**

Monitoring equipment consisting of a photoionization detector (PID) and water quality instrument will be calibrated according to the manufacturer's instructions.

### **Sample Collection and Sample Handling Tasks**

The sampling and analysis design and rationale are described in Section 7.0. Sample collection will be in accordance with the site-specific SOPs listed in Section 8.3. The sampling requirements for each type of analysis (i.e., bottleware, preservation, holding time) are listed in Section 8.5. Field and laboratory QC samples will also be collected as outlined in Section 8.6.

### **Permanent Monitoring Well Sampling**

Monitoring Well 16MW06 will be purged and sampled using low-flow sampling techniques in accordance with the NJDEP Field Sampling Procedures Manual using a submersible pump. The pump will be positioned at the middle of the submerged length of well screen. The pumping rate will be set at between 0.1 to 0.4 liters/minute. The purge water discharge will be monitored for pH, specific conductivity,

turbidity, redox potential, and dissolved oxygen. When the levels of these parameters stabilize, and a minimum of one saturated screen volume has been removed from the well, the purging is complete and sampling can begin. Parameter stabilization is defined as three successive readings (taken at least 5 minutes apart) within 0.1 unit for pH, 3% for conductivity, 10% for turbidity and DO, and 10 mv for redox potential. The pumping rate will be controlled and the well's water level will be constantly monitored. The vertical location of the pump, the required minimum purge volume, and the calculations for parameter stabilization will be recorded on the groundwater sample log sheet.

### **Temporary Well Sampling**

Temporary monitoring well points will be created by inserting slotted PVC pipe into the DPT probe hole after the probe rods are removed. In accordance with VIT Guidance, the well will be screened across the water table, and the sample from the well will be representative of 10 feet or less of water column in the well. The well points will be developed with a peristaltic pump or inertial pump to remove excess silt or sand that may have entered the well point. Groundwater samples from the temporary well points will be collected using a bailer or an inertial pump.

Groundwater samples will be collected in accordance with NJDEP Field Sampling Procedures Manual (FSPM) (NJDEP, 2005) Section 6.9 Groundwater Sampling Procedures and with Tetra Tech SOP SA-2.5. The soil borings will be logged according to the procedures described in Tetra Tech SOP GH-1.5. These SOPs are included in Appendix A.

The groundwater samples will be placed in coolers, refrigerated with wet ice, and submitted under chain of custody protocol to a fixed-base laboratory for the parameters listed in Section 8.5.

The temporary monitoring wells will be left in place to accommodate up to two additional sampling rounds, if necessary, based on the initial sampling results (see Section 5.4).

### **Basement Sump Sampling**

Basement sumps (if present) will be sampled by filling the sample containers directly from the sump. Basement sump samples will be collected in accordance with NJDEP FSPM (NJDEP, 2005) Section 6.8 Surface Water and Sediment Sampling Procedures and with Tetra Tech SOP SA-1.2. The samples will be placed in coolers, refrigerated with wet ice, and submitted under chain of custody protocol to a fixed-base laboratory for the parameters listed in Section 8.5.

The sumps will be visually checked for the presence of free product by first screening the sump for organic vapors with a PID. If the assessment indicates the presence of LNAPL in a given well, an interface probe will be used to determine the thickness of the LNAPL layer. The probe is inserted into the well and provides an audible alarm when the top of the LNAPL layer is reached. A second audible alarm is given when the top of water is reached. Subtracting the second measurement (top of water) from the first measurement (top of LNAPL) gives the LNAPL thickness.

### **Surveying**

A New Jersey-licensed surveyor will be subcontracted by Tetra Tech to survey the horizontal location of each of the temporary well locations. Each of the borings and/or well locations will be surveyed relative to the coordinates of established site benchmarks. The horizontal measurements shall use the North American Datum of 1983 (NAD83) and be accurate to within 0.1 foot.

### **Investigation-Derived Waste Management**

It is anticipated that waste materials will be generated during the field investigation. These wastes must be disposed in such a manner as to not contribute to further environmental contamination or pose a threat to public health or safety. These materials include:

- Decontamination fluid
- Used personal protective equipment (PPE)
- Used sampling equipment
- Soil from DPT borings
- Well development water
- Well purge water

IDW will be handled in the following manner:

- Visibly clear phosphate-free detergent wash water and rinse water decontamination fluids from sampling equipment will be released to the ground upon rinsing, in the immediate vicinity of its point of generation. If warranted based on its condition, the decontamination rinse water will be contained in 55-gallon drums or bulk containers.
- Used PPE such as sampling gloves, Tyvek coveralls, paper towels, or other materials will be bagged and sealed prior to disposal of general refuse. If PPE becomes grossly contaminated, it will be segregated from other PPE, labeled and staged as "contaminated material". Contaminated material

will be drummed and staged in the IDW area designated by the NWS Earle POC. Tetra Tech will arrange for off-site disposal of drums by a licensed waste hauler at an approved facility.

- Used sampling equipment, which generally has minor contamination, will be disposed of with the PPE as general refuse. Contaminated disposable equipment will require segregation from other equipment and proper disposal.
- Soil from DPT borings will be containerized for off-site disposal.
- Water generated during the development and purging of the site wells, prior to and during groundwater sampling, will be containerized in 55-gallon drums for off-site disposal.

### **Field Decontamination Procedures**

Decontamination will be performed according to the procedures described in Tetra Tech SOP SA-7.1 presented in Appendix A. Decontamination of non-dedicated sampling equipment (e.g., submersible pump) will be conducted prior to and between sampling at each location. The following sequence will be implemented:

- Detergent wash (Alconox)
- Tap water rinse
- Distilled water rinse
- Air dry

### **Field Documentation Procedures**

Field documentation will be performed in accordance with SOP SA-6.3 presented in Appendix A.

A summary of all field activities will be properly recorded in a bound logbook with consecutively numbered pages that cannot be removed. Logbooks will be assigned to field personnel and will be stored in a secured area when not in use.

All entries will be written in indelible ink and no erasures will be made. If an incorrect entry is made, striking a single line through the incorrect information will make the correction; the person making the correction will initial and date the change. Boring logs, sampling forms, and other field forms will also be used to document field activities.

At a minimum, the following information will be recorded in the site logbook:

- Name of the person to whom the logbook is assigned.
- Project name.
- Project start date.
- Names and responsibilities of on-site project personnel including subcontractor personnel.
- Arrival/departure of site visitors.
- Arrival/departure of equipment.
- Sampling activities and sample log sheet references.
- Description of subcontractor activities.
- Sample pick-up information including chain-of-custody numbers, air bill numbers, carrier, time, and date.
- Description of borehole or monitoring well installation activities and operations.
- Health and safety issues.
- Description of photographs including date, time, photographer, roll and picture number, location, and compass direction of photograph.

### **Quality Control Tasks**

QC samples will be collected at frequencies listed in Section 6.0.

## **8.2 ADDITIONAL PROJECT-RELATED TASKS**

Additional project-related tasks include:

- Analytical Tasks
- Data Management
- Data Review
- Project Reports

### **Analytical Tasks**

Chemical analysis of groundwater samples will be performed by Chemtech, which is a DoD Environmental Laboratory Accreditation Program (ELAP)-accredited and NJDEP certified laboratory (DoD, ELAP, and NJDEP accreditation documentation are included in Appendix B). The analysis will be performed in accordance with the analytical method identified in Section 8.5. Chemtech will perform the chemical analysis following the laboratory-specific SOP identified in Section 10.0. A copy of the Laboratory SOP is available to the Project Team upon request.

The analytical data packages provided by Chemtech will be in a Contract Laboratory Program (CLP)-like format and will be fully validatable and contain raw data, summary forms for all sample and laboratory method blank data, and summary forms containing all method-specific quality control (QC) information [results, percent recoveries (%Rs), RPDs, relative standard deviations (RSDs), percent differences or percent drifts (%Ds), etc.].

### **Data Management**

The principal data generated for this project will be from field data and laboratory analytical data. Field sampling log sheets will be organized by date and medium, and filed in the project files. The field logbooks for this project will be used only for this site and will also be categorized and maintained in the project files after the completion of the field program. Project personnel completing concurrent field sampling activities may maintain multiple field logbooks. When possible, logbooks will be segregated by sampling activity. The field logbooks will be titled based on date and activity.

The data handling procedures to be followed by Chemtech will meet the requirements of the technical specifications. Electronic data results will be automatically downloaded into the Tetra Tech database in accordance with the proprietary Tetra Tech processes.

The Tetra Tech PM (or designee) is responsible for the overall tracking and control of data generated for the project.

- **Data Tracking.** Data are tracked from generation to archiving in the Tetra Tech project-specific files. The Tetra Tech Project Chemist (or designee) is responsible for tracking the samples collected and shipped to Chemtech. Upon receipt of the data packages from Chemtech, the Tetra Tech Project Chemist will monitor the data validation effort, which includes verifying that the data packages are complete and results for all samples have been delivered by Chemtech.
- **Data Storage, Archiving, and Retrieval.** The data packages received from Chemtech are tracked in the data validation logbook. After the data are validated, the data packages are entered into the Tetra Tech Navy Comprehensive Long-term Environmental Action Navy (CLEAN) file system and archived in secure files. The field records including field log books, sample logs, chain-of-custody records, and field calibration logs will be submitted by the Tetra Tech FOL to be entered into the Navy CLEAN file system prior to archiving in secure project files. Project files are audited for accuracy and completeness. At the completion of the Navy contract, the records will be stored by Tetra Tech.

- **Data Security.** Access to Tetra Tech project files is restricted to designated personnel only. Records can only be borrowed temporarily from the project file using a sign-out system. The Tetra Tech Data Manager maintains the electronic data files, and access to the data files is restricted to qualified personnel only. File and data backup procedures are routinely performed.
- **Electronic Data.** All electronic data will be compiled into a Naval Installation Restoration Information Solution (NIRIS) Electronic Data Deliverable (NEDD) and loaded into NIRIS.

### **Data Review**

This review comprises data verification, validation, and usability assessment. The data verification and validation processes and requirements are described in Section 12.0 and the data usability assessment is described below.

At the direction of the Tetra Tech PM, a data usability assessment will be performed by key individuals (e.g., the project geologist, project chemist, statistician, and/or risk assessor) on behalf of the Project Team. The objective will be to evaluate all aspects of data quality and usability in the context of the problem statement and decisions to be made to determine whether the project data are usable as intended. Key elements of this review, several of which relate to performance specifications in field and laboratory SOPs and individual SAP sections, are as follows:

- Precision – Ensuring project precision objectives are satisfied and that laboratory precision is no less precise than field precision.
- Accuracy – Ensuring project accuracy objectives are satisfied.
- Sensitivity – Ensuring analytical sensitivity goals were achieved.
- Completeness – Ensuring that all of the scheduled sampling and analysis was completed.
- Comparability – Ensuring data are comparable enough to satisfy project objectives and that current data are projected to be comparable to future data, as necessary.
- Representativeness – Ensuring samples were collected from the intended locations and depths, and at the specified times, and that the analyses were conducted as specified in this SAP.

These evaluations require reviews across data packages rather than the individual data package reviews conducted during data validation. Non-detects will be represented by one-half the LOD.

Additional evaluations, conducted at the Tetra Tech PM direction, may be necessary to explore physical and chemical relationships. Examples include but are not limited to:



- Evaluating soil boring logs and well construction diagrams to determine whether any physical anomalies may have been present and that all physical anomalies have been considered when evaluating the representativeness and comparability of data.
- Evaluating groundwater characteristics such as seepage velocities, pH, ORP, and specific conductivity in the context of the geologic formation (coal/shale versus limestone/sandstone) to assess whether the reported values are reasonable.
- Evaluating tidal study data to ensure sample collection times were appropriate.

If data are found to be usable for their intended purpose, the data usability assessment output will be one or more standard report tables indicating data qualifications for each analytical result. If significant usability limitations are identified, the Tetra Tech PM will determine how best to represent the data limitations. These limitations will be shared with the rest of the Project Team for their evaluation before finalization of the project report.

### **Project Reports**

Draft and final versions of the project report will be prepared and submitted to the Navy and NJDEP for review. The report will include the following sections:

- Executive Summary – will include a brief description of the work conducted and the findings.
- Introduction and Background – will include a description of the history of operations and activities at the site and a summary of any previous investigations and removal actions.
- Description of Field Investigations – will include a summary of the work performed in accordance with the approved SAP, any approved SAP addenda, and any field modifications as documented by the Tetra Tech FOL. This section will include maps showing the sampling locations and tables summarizing the data collected.
- Data Quality – will include a summary of quantitative analytical performance indicators such as completeness, precision, bias, and sensitivity and qualitative indicators such as representativeness and comparability. This section will also include a reconciliation of project data with the DQOs and identification of deviations from this SAP.

A data usability assessment will be used to identify significant deviations in analytical performance that could affect the ability to meet project objectives. The elements of this review are presented in Section 12.0.

- Nature and Extent of Contamination – will include a discussion of the contamination detected in each medium sampled in relation to the CSM of the site. Detected contaminant concentrations will be tabulated for each medium and depicted on maps.
- Summary and Conclusions – includes a summary of the findings, conclusions as to whether sample data is adequate to resolve the decision rule, and recommendations for further investigations, if needed.

The final version of the report will submitted in hardcopy and electronic format to the project stakeholders.

### 8.3 Field SOPs Reference Table

(UFP-QAPP Manual Section 3.1.2 – Worksheet #21)

Reference Number	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
CT-04	Sample Nomenclature (Revision 3, 1/2012)	Tetra Tech	NA	N	Contained in Appendix A.
GH-1.3	Soil and Rock Drilling Methods (Revision 2, 1/2012)	Tetra Tech	Drilling or DPT rig, accessories, and general field supplies	N	Contained in Appendix A.
GH-1.5	Borehole and Sample Logging (Revision 2, 1/2012)	Tetra Tech	General field supplies	N	Contained in Appendix A.
GH-2.8	Groundwater Monitoring Well Installation (Revision 4, 1/2012)	Tetra Tech	Health and safety equipment, well drilling and installation equipment, hydrogeologic equipment, drive point installation tools	N	Contained in Appendix A.
HS-1.0	Utility Locating and Excavation Clearance (Revision 3, 1/2012)	Tetra Tech	NA	N	Contained in Appendix A.
NJDEP FSPM Section 6.8	Surface Water and Sediment Sampling Procedures	NJDEP	General field supplies	N	Contained in Appendix A. See Section 8.1 for project-specific procedures.
NJDEP FSPM Section 6.9	Groundwater Sampling Procedures	NJDEP	Submersible pump, multi-parameter meter, turbidimeter	N	Contained in Appendix A. See Section 8.1 for project-specific procedures.
SA-1.1	Groundwater Sample Acquisition and Onsite Water Quality Testing (Revision 8, 1/2012)	Tetra Tech	Multi-parameter water quality meter, such as a Horiba U-52	Y	NJDEP groundwater sampling procedure supersedes Tetra Tech procedure. Tetra Tech log sheets will be used. SOP contained in Appendix A.

Reference Number	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
SA-1.2	Surface Water and Sediment Sampling	Tetra Tech	General field supplies	Y	NJDEP groundwater sampling procedure supersedes Tetra Tech procedure. Tetra Tech log sheets will be used. SOP contained in Appendix A.
SA-2.5	Direct Push Technology (Geoprobe®/Hydropunch™) (Revision 4, January 2012)	Tetra Tech	DPT Rig, accessories, and supplies	N	Contained in Appendix A.
SA-6.1	Non-Radiological Sample Handling (Revision 4, 1/2012)	Tetra Tech	Sample Bottle ware, Packaging Material, Shipping Materials	N	Contained in Appendix A.
SA-6.3	Field Documentation (Revision 4, 1/2012)	Tetra Tech	Field Logbook, Field Sample Forms, Boring Logs	N	Contained in Appendix A.
SA-7.1	Decontamination of Field Equipment (Revision 7, 1/2012)	Tetra Tech	Decontamination Equipment (scrub brushes, phosphate free detergent, de-ionized water)	Y	Contained in Appendix A.

## 8.4 Sample Details Table

(UFP-QAPP Manual Section 3.1.1 and 3.5.2.3 – Worksheet #18)

Sample Location	Sample ID	Sample Rationale	Sample Depth <sup>(1)</sup> (feet bgs)	Sampling SOP <sup>(2)</sup>	Laboratory Analysis	Field Analyses						
					VOCs	Water Level	Temperature	pH	Spec. Cond.	ORP	DO	Turbidity
16MW06	16MW06-YYYYMMDD <sup>(3)</sup>	Determine groundwater VOC concentrations in vicinity of Buildings C-63 and S-83	7-17	SA-1.1, NJ FSPM 6.9	•	•	•	•	•	•	•	•
C63SUMP <sup>(4)</sup>	C63SUMP-YYYYMMDD	Determine the VOC concentrations in the water in the Building C63 sump	TBD	SA-1.2, NJ FSPM 6.8	•							
S83SUMP <sup>(4)</sup>	S83SUMP-YYYYMMDD	Determine the VOC concentrations in the water in the Building S83 sump	TBD	SA-1.2, NJ FSPM 6.8	•	•	•	•	•	•	•	•
C15 SUMP <sup>(4)</sup>	C15 SUMP-YYYYMMDD	Determine the VOC concentrations in the water in the Building C15 sump	TBD	SA-1.2, NJ FSPM 6.8	•	•	•	•	•	•	•	•
C18SUMP <sup>(4)</sup>	C18SUMP-YYYYMMDD	Determine the VOC concentrations in the water in the Building C18 sump	TBD	SA-1.2, NJ FSPM 6.8	•	•	•	•	•	•	•	•
C19SUMP <sup>(4)</sup>	C19SUMP-YYYYMMDD	Determine the VOC concentrations in the water in the Building C19 sump	TBD	SA-1.2, NJ FSPM 6.8	•	•	•	•	•	•	•	•
C50 SUMP <sup>(4)</sup>	C50SUMP-YYYYMMDD	Determine the VOC concentrations in the water in the Building C50 sump	TBD	SA-1.2, NJ FSPM 6.8	•	•	•	•	•	•	•	•
C63TW01	C63GW01-YYYYMMDD <sup>(3,4)</sup>	Determine groundwater benzene concentration at critical distance from Building C-63	7-12	SA-1.1, NJ FSPM 6.9	•	•	•	•	•	•	•	•

Sample Location	Sample ID	Sample Rationale	Sample Depth <sup>(1)</sup> (feet bgs)	Sampling SOP <sup>(2)</sup>	Laboratory Analysis	Field Analyses						
					VOCs	Water Level	Temperature	pH	Spec. Cond.	ORP	DO	Turbidity
S83TW01	S83GW01-YYYYMMDD <sup>(5)</sup>	Determine groundwater benzene concentration at critical distance from Building S-83	7-12	SA-1.1, NJ FSPM 6.9	.	.	.	.	.	.	.	.
S83TW01	S83DUP01-YYYYMMDD	Field duplicate	7-12	SA-1.1, NJ FSPM 6.9	.	.	.	.	.	.	.	.
C15TW01	C15GW01-YYYYMMDD	Determine groundwater benzene concentration at critical distance from Building C-15	7-12	SA-1.1, NJ FSPM 6.9	.	.	.	.	.	.	.	.
C15TW02	C15GW02-YYYYMMDD	Determine groundwater benzene concentration at critical distance from Building C-15	7-12	SA-1.1, NJ FSPM 6.9	.	.	.	.	.	.	.	.
C18TW01	C18GW01-YYYYMMDD	Determine groundwater benzene concentration at critical distance from Building C-18	7-12	SA-1.1, QAD023N J FSPM 6.9	.	.	.	.	.	.	.	.
C19TW01	C19GW01-YYYYMMDD	Determine groundwater benzene concentration at critical distance from Building C-19	7-12	SA-1.1, NJ FSPM 6.9	.	.	.	.	.	.	.	.
C50TW01	C50GW01-YYYYMMDD	Determine groundwater benzene concentration at critical distance from Building C-50	7-12	SA-1.1, QAD023N J FSPM 6.9	.	.	.	.	.	.	.	.

<sup>(1)</sup> Depths are estimated for proposed temporary wells. Actual depths may vary based on site conditions. Well screens will be placed to intercept the water table; sample depth corresponds to the estimated submerged screen length.

<sup>(2)</sup> SOP or SAP section that describes the sample collection procedures (Section 8.3).

<sup>(3)</sup> YYYYMMDD represents the year, month, and date that the sample is collected.

<sup>(4)</sup> Sample will be collected only if there is a basement sump containing sufficient water to be sampled.

<sup>(5)</sup> Placement of temporary wells near Buildings C-63 and S-83 is conditional upon the results of the groundwater sample from well 16MW06.

## 8.5 Analytical SOP Requirements and Analytical Services Table

(UFP-QAPP Manual Section 3.1.1 - Worksheets #19 and 30)

**Laboratory point of contact, e-mail address, and phone number:** Reginald Saint-Juste, Reginald@chemtech.net, 908-728-3147

**Laboratory Name and Address:** Chemtech, 284 Sheffield Street, Mountainside, NJ 07092

**Data Package Turnaround time:** 21 days

**Tentative Sampling Dates:** January 2014

Matrix	Analytical Group	Analytical and Preparation Method / SOP Reference <sup>1</sup>	Containers (number, size, and type)	Sample Volume (units)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation / analysis)
Groundwater and Aqueous Field QC Samples	VOC	SW-846 5030B/ 8260B/ SOP M8260B-C- SWGCMSSVOA	3 - 40 milliliter (mL) vials with Teflon-lined septa	5 mL	Hydrochloric Acid (HCl) to pH<2; Cool to < 6°C	14 days to analysis

Notes:

<sup>(1)</sup>The reference letter or number corresponds to the Analytical SOP References table (Section 10.0).

## 8.6 Field Quality Control Sample Summary Table

(UFP-QAPP Manual Section 3.1.1 - Worksheet #20)

Matrix	Analytical Group	No. of Sampling Locations	No. of Field Duplicates	No. of MS/MSDs <sup>(1)</sup>	No. of Equip. Blanks	No. of VOA Trip Blanks	Total No. of Samples to Lab
Groundwater (temp. wells)	VOC	7	1	1/1	1	2	11
Groundwater (sumps)	VOC	6	1	1/1	NA	1	8
Groundwater (16MW06)	VOC	1	1	1/1	1	1	4

- <sup>(1)</sup> Although MS/MSD samples are not typically considered field QC samples, they are included here because location determination is often established in the field. MS/MSD samples are not included in the total number of samples sent to the laboratory.



## 9.0 -- Reference Limits and Evaluation Tables

(UFP-QAPP Manual Section 2.8.1 – Worksheet #15)

**Matrix:** Groundwater

**Analytical Group:** VOC (SW-846 Method 8260B)

Analyte	CAS Number	PAL (µg/L)	PAL References <sup>(1)</sup>	PQLG (µg/L)	Chemtech <sup>(2)</sup>		
					LOQ (µg/L)	LOD (µg/L)	DL (µg/L)
Acetone	67-64-1	21,000,000	VI GWSL	7,000,000	5	1	0.5
Benzene	71-43-2	20	VI GWSL	6.7	1	0.2	0.2
Bromodichloromethane	75-27-4	2	VI GWSL	0.67	1	0.2	0.2
Bromoethene <sup>(3)</sup>	593-60-2	0.2	VI GWSL	0.067	TBD	TBD	TBD
Bromoform	75-25-2	300	VI GWSL	100	1	0.2	0.2
Bromomethane	74-83-9	20	VI GWSL	6.7	1	0.2	0.2
1,3-Butadiene <sup>(3)</sup>	106-99-0	0.3	VI GWSL	0.1	TBD	TBD	TBD
2-Butanone	78-93-3	2,500,000	VI GWSL	830,000	5	2.5	1.3
Carbon disulfide	75-15-0	1,500	VI GWSL	500	1	0.2	0.2
Carbon tetrachloride	56-23-5	1	VI GWSL	0.33	1	0.2	0.2
Chlorobenzene	108-90-7	770	VI GWSL	260	1	0.2	0.2
Chloroethane	75-00-3	26,000	VI GWSL	8,700	1	0.5	0.2
Chloroform	67-66-3	70	VI GWSL	23	1	0.2	0.2
Chloromethane	74-87-3	240	VI GWSL	80	1	0.2	0.2
3-Chloropropene <sup>(3)</sup>	107-05-1	1	VI GWSL	0.33	TBD	TBD	TBD
Cyclohexane	110-82-7	16,000	VI GWSL	5,300	1	0.2	0.2
Dibromochloromethane	124-48-1	6	VI GWSL	2	1	0.2	0.2
1,2-Dibromoethane	106-93-4	0.4	VI GWSL	0.13	1	0.2	0.2
1,2-Dichlorobenzene	95-50-1	6,800	VI GWSL	2,300	1	0.2	0.2

Analyte	CAS Number	PAL (µg/L)	PAL References <sup>(1)</sup>	PQLG (µg/L)	Chemtech <sup>(2)</sup>		
					LOQ (µg/L)	LOD (µg/L)	DL (µg/L)
1,4-Dichlorobenzene	106-46-7	75	VI GWSL	25	1	0.2	0.2
Dichlorodifluoromethane	75-71-8	1,000	VI GWSL	330	1	0.2	0.2
1,1-Dichloroethane	75-34-3	50	VI GWSL	17	1	0.2	0.2
1,2-Dichloroethane	107-06-2	3	VI GWSL	1	1	0.2	0.2
1,1-Dichloroethene	75-35-4	260	VI GWSL	87	1	0.2	0.2
trans-1,2-Dichloroethene	156-60-5	520	VI GWSL	170	1	0.2	0.2
1,2-Dichloropropane	78-87-5	4	VI GWSL	1.3	1	0.2	0.2
1,3-Dichloropropene <sup>(3)</sup>	542-75-6	7	VI GWSL	2.3	TBD	TBD	TBD
Ethylbenzene	100-41-4	700	VI GWSL	230	1	0.2	0.2
Hexachlorobutadiene	87-68-3	1	VI GWSL	0.33	1	0.2	0.2
n-Hexane <sup>(3)</sup>	110-54-3	160	VI GWSL	53	TBD	TBD	TBD
Methylene chloride	75-09-2	920	VI GWSL	310	1	0.2	0.2
4-Methyl-2-pentanone	108-10-1	900,000	VI GWSL	300,000	5	1	1
Methyl tert-butyl ether (MTBE)	1634-04-4	580	VI GWSL	190	1	0.5	0.35
Naphthalene	91-20-3	300	VI GWSL	100	1	0.2	0.2
Styrene	100-42-5	180,000	VI GWSL	60,000	1	0.2	0.2
1,1,2,2-Tetrachloroethane	79-34-5	6	VI GWSL	2	1	0.2	0.2
Tetrachloroethene	127-18-4	31	VI GWSL	10	1	0.2	0.2
Toluene	108-88-3	330,000	VI GWSL	110,000	1	0.2	0.2
1,2,4-Trichlorobenzene	120-82-1	130	VI GWSL	43	1	0.2	0.2
1,1,1-Trichloroethane	71-55-6	13,000	VI GWSL	4,300	1	0.2	0.2
1,1,2-Trichloroethane	79-00-5	8	VI GWSL	2.7	1	0.2	0.2
Trichloroethene	79-01-6	2	VI GWSL	0.67	1	0.2	0.2
Trichlorofluoromethane	75-69-4	2,000	VI GWSL	670	1	0.2	0.2

**Project-Specific SAP****Site Name/Project Name:** NWS Earle**Site Location:** Colts Neck, New Jersey**Title:** SAP for Site 16/F Vapor Intrusion Groundwater Investigation**Revision Number:** 0**Revision Date:** February 2014

Analyte	CAS Number	PAL (µg/L)	PAL References <sup>(1)</sup>	PQLG (µg/L)	Chemtech <sup>(2)</sup>		
					LOQ (µg/L)	LOD (µg/L)	DL (µg/L)
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	3,700	VI GWSL	1,200	1	0.5	0.2
Vinyl chloride	75-01-4	1	VI GWSL	0.33	1	0.2	0.2
Xylenes (total)	1330-20-7	8,600	VI GWSL	2,900	3	0.6	0.6

CAS – Chemical Abstracts Service

µg/L – micrograms per liter

PQLG – Project Quantitation Limit Goal

<sup>(1)</sup> The PAL reference for groundwater is: VI GWSL – NJDEP Generic Groundwater Screening Level for Vapor Intrusion (March 2013).<sup>(2)</sup> Chemtech DL/LODs/LOQs are current as of November 2013.<sup>(3)</sup> This compound will be analyzed by library search and is considered a tentatively identified compound.

**10.0 -- Analytical SOP References Table**  
(UFP-QAPP Manual Section 3.2.1 – Worksheet #23)

Lab SOP Number	Title, Revision Date, and / or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Variance to DOD QSM? (Y/N)	Modified for Project Work? (Y/N)
M8260B-C-SWGCMSSVOA	Volatile Organic Compounds by GC/MS – SW-846 Method 8260B/C (Revision 18, 02/15/11)	Definitive	Groundwater and Aqueous QC samples / VOC	Gas Chromatograph/ Mass Spectrometer (GC/MS)	Chemtech	N	N

Chemtech currently has DOD ELAP and NJDEP accreditation (Appendix B) for the indicated analyses in groundwater.

## 11.0 -- Laboratory QC Samples Tables

(UFP-QAPP Manual Section 3.4 – Worksheet #28)

<b>Matrix</b>	Groundwater, and Aqueous Field QC Samples					
<b>Analytical Group</b>	VOC					
<b>Analytical Method/SOP Reference</b>	SW-846 8260B/ M8260B-C-SWGCMSVOA					
<b>QC Sample</b>	<b>Frequency/Number</b>	<b>Method/SOP QC Acceptance Limits</b>	<b>Corrective Action</b>	<b>Person(s) Responsible for Corrective Action</b>	<b>Data Quality Indicator</b>	<b>Measurement Performance Criteria</b>
Method Blank	One per batch of 20 samples or less per matrix.	All target analytes must be $\leq$ $\frac{1}{2}$ LOQ.	Re-clean, retest, re-extract, reanalyze. If reanalysis cannot be performed, qualify data.	Analyst, Supervisor	Bias / Contamination	Same as QC Acceptance Limits.
Surrogates	All field and QC samples. Two per sample- Dibromofluoromethane Toluene-d <sub>8</sub>	%R must be within laboratory statistically-derived or DoD QSM acceptance limits (Version 4.2).	Check calculations for errors, check instrument performance, re-extract and re-analyze the samples if the above show no problems or flag the data if sample matrix interference is present.	Analyst, Supervisor	Accuracy / Bias	Same as QC Acceptance Limits.
Internal Standards (IS)	Every field sample, standard, and QC sample. Four per sample- Pentafluorobenzene 1,4-Difluorobenzene Chlorobenzene-d <sub>5</sub> 1,4-Dichlorobenzene-d <sub>4</sub>	Retention Times (RTs) for each IS must be within $\pm$ 30 seconds and the responses must be within -50% to +100% of initial calibration (ICAL) mid-point standard.	Inspect MS or GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.	Analyst, Supervisor	Accuracy / Bias	Same as QC Acceptance Limits.
Laboratory Control Sample (LCS) Laboratory Control Sample Duplicate (LCSD) (Not Required)	One per batch of 20 samples or less per matrix.	%Rs must be within laboratory statistically derived or DoD QSM acceptance limits (Version 4.2).  RPD must be $\leq$ 30% (for LCS/LCSD, if analyzed).	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Refer to DOD QSM Version 4.2 Table G-1 for number of marginal exceedances allowed. Contact Client if samples cannot be reprepared within hold time.	Analyst, Supervisor	Accuracy / Bias Precision also, if LCSD is analyzed	Same as QC Acceptance Limits.

**Project-Specific SAP**  
**Site Name/Project Name:** NWS Earle  
**Site Location:** Colts Neck, New Jersey

**Title:** SAP for Site 16/F Vapor Intrusion Groundwater Investigation  
**Revision Number:** 0  
**Revision Date:** February 2014

<b>Matrix</b>	Groundwater, and Aqueous Field QC Samples					
<b>Analytical Group</b>	VOC					
<b>Analytical Method/SOP Reference</b>	SW-846 8260B/ M8260B-C-SWGCMSVOA					
<b>QC Sample</b>	<b>Frequency/Number</b>	<b>Method/SOP QC Acceptance Limits</b>	<b>Corrective Action</b>	<b>Person(s) Responsible for Corrective Action</b>	<b>Data Quality Indicator</b>	<b>Measurement Performance Criteria</b>
MS/MSD	One per batch of 20 or fewer samples per matrix.	%R should be within laboratory statistically derived or DoD QSM acceptance limits (Version 4.2). RPD between MS and MSD should be $\leq 30\%$ .	Evaluate the sample spiked for matrix interference and flag the data as necessary. Examine the project DQOs and contact the client.	Analyst, Supervisor	Accuracy / Bias Precision	Same as QC Acceptance Limits.
Results between the DL and LOQ	NA.	Apply "J" qualifier to results detected between DL and LOQ.	None.	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits.

## 12.0 -- Data Verification and Validation (Steps I and IIa/IIb) Process Table

(UFP-QAPP Manual Section 5.2.1, UFP-QAPP Manual Section 5.2.2, Figure 37 UFP-QAPP Manual, Table 9 UFP-QAPP Manual – Worksheets #34, 35, 36)

Data Review Input	Description	Responsible for Verification (name, organization)	Internal/ External
Chain of Custody Forms	The Tetra Tech FOL or designee will review and sign the chain-of-custody form to verify that all samples listed are included in the shipment to the laboratory and the sample information is accurate. The forms will be signed by the sampler and a copy will be retained for the project file, the Tetra Tech PM, and the Tetra Tech Data Validators. The Tetra Tech FOL or designee will review the chain-of-custody form to verify that all samples listed in the SAP have been collected. All deviations should be documented in the report.	Sampler and FOL, Tetra Tech	Internal
Chain of Custody Forms	1 - The Laboratory Sample Custodian will review the sample shipment for completeness and integrity, and sign accepting the shipment.  2- The Tetra Tech Data Validators will check that the chain-of-custody form was signed and dated by the Tetra Tech FOL or designee relinquishing the samples and also by the Laboratory Sample Custodian receiving the samples for analyses.	1 - Laboratory Sample Custodian, Chemtech  2 - Data Validators, Tetra Tech	External
Chain of Custody Forms and SAP	Ensure that the custody and integrity of the samples was maintained from collection to analysis and the custody records are complete and any deviations are recorded. Review that the samples were shipped and stored at the required temperature and preservation conditions for chemically-preserved samples meet the requirements listed in the SAP. Ensure that the analyses were performed within the holding times listed in the SAP.	Data Validators, Tetra Tech	External

<b>Data Review Input</b>	<b>Description</b>	<b>Responsible for Verification (name, organization)</b>	<b>Internal/ External</b>
Sample Log Sheets, Chain of Custody Forms, SAP, and Laboratory Sample Login Documentation	Verify that information recorded in the log sheets is accurate and complete. Verify that samples were correctly identified, that sampling location coordinates are accurate, and that documentation establishes an unbroken trail of documented chain-of-custody from sample collection to report generation. Verify that the correct sampling and analytical methods/SOPs were applied. Verify that the sampling plan was implemented and carried out as written and that any deviations are documented. Document any discrepancies in the final report.	PM, FOL, or designee, Tetra Tech	Internal
SAP, Analytical SOPs, and Analytical Data Packages	Ensure that all laboratory SOPs were followed. Verify that the correct analytical methods/SOPs were applied. Establish that all method QC samples were analyzed and in control as listed in the analytical SOPs. If method quality assurance is not in control, the Laboratory QAM will contact the Tetra Tech PM verbally or via e-mail for guidance prior to report preparation.	Laboratory QAM, Chemtech	Internal
SAP/ Chain-of-Custody Forms	Check that all field QC samples determined necessary were collected as required.	FOL or designee, Tetra Tech	Internal
Analytical Data Packages	Verify all analytical data packages for completeness. The Laboratory QAM will sign the case narrative for each data package.	Laboratory QAM, Chemtech	Internal
NEDDs/ Analytical Data Packages	Check each NEDD against the chain-of-custody and hard copy data package for accuracy and completeness. Compare laboratory analytical results to the electronic analytical results to verify accuracy. Evaluate sample results for laboratory contamination and qualify false detections using the laboratory method/preparation blank summaries. Qualify analyte concentrations between the DL and the LOQ as estimated. Remove extraneous laboratory qualifiers from the validation qualifier.	Data Validators, Tetra Tech	External
Analytical Data Packages	Verify each data package for completeness. Request missing information from the Laboratory PM.	Data Validators, Tetra Tech	External



<b>Data Review Input</b>	<b>Description</b>	<b>Responsible for Verification (name, organization)</b>	<b>Internal/ External</b>
SAP/ Laboratory Data Packages/ NEDDs	Ensure that the laboratory QC samples were analyzed and that the Measurement Performance Criteria (MPCs) were met for all field samples and QC analyses. Check that specified field QC samples were collected and analyzed and that the analytical QC criteria set up for this project were met.	Data Validators, Tetra Tech	External
SAP/ Laboratory Data Packages/ NEDDs	Check the field sampling precision by calculating RPDs for field duplicate samples. Check laboratory precision by reviewing the RPD or percent difference values from laboratory duplicate analyses; MS/MSDs; and LCS/LCSD, if available. Ensure compliance with the methods and project MPCs accuracy goals listed in the SAP.	Data Validators, Tetra Tech	External
SAP/ Laboratory Data Packages/ NEDDs	Check that the laboratory recorded the temperature at sample receipt and the pH of samples preserved with acid or base to ensure sample integrity from sample collection to analysis.	Data Validators, Tetra Tech	External
SAP/ Laboratory Data Packages/ NEDDs	Review the chain-of-custody forms generated in the field to ensure that the required analytical samples have been collected, appropriate sample identifications have been used, and correct analytical methods have been applied. The Tetra Tech Data Validator will verify that elements of the data package required for validation are present, and if not, the laboratory will be contacted and the missing information will be requested. Check that all data have been transferred correctly and completely to the project Structured Query Language (SQL) database.	Data Validators, Tetra Tech	External
SAP/ Laboratory Data Packages/ NEDDs	Ensure that the project LOQs listed in SAP were achieved.	Data Validators, Tetra Tech	External
SAP/ Laboratory Data Packages/ NEDDs	Discuss the impact on DLs that are elevated because of matrix interferences. Be especially cognizant of and evaluate the impact of sample dilutions on low-concentration analytes when the dilution was performed because of the high concentration of one or more other contaminants. Document this usability issue and inform the Tetra Tech PM. Review and add PALs to the laboratory NEDDs. Flag samples and notify the Tetra Tech PM of samples that exceed PALs listed in SAP.	Data Validators, Tetra Tech	External

<b>Data Review Input</b>	<b>Description</b>	<b>Responsible for Verification (name, organization)</b>	<b>Internal/ External</b>
SAP/ Laboratory Data Packages/ NEDDs	Ensure that all QC samples specified in the SAP were collected and analyzed and that the associated results were within prescribed SAP acceptance limits. Ensure that QC samples and standards prescribed in analytical SOPs were analyzed and within the prescribed control limits. If any significant QC deviations occur, the Laboratory QAM shall have contacted the Tetra Tech PM.	Data Validators, Tetra Tech	External
SAP/ Laboratory Data Packages/ NEDDs	Summarize deviations from methods, procedures, or contracts in the Data Validation Report. Determine the impact of any deviation from sampling or analytical methods and SOP requirements and matrix interferences effect on the analytical results. Qualify data results based on method or QC deviation and explain all the data qualifications. Print a copy of qualified data stored in the project database to depict data qualifiers and data qualifier codes that summarize the reason for data qualifications. Determine if the data met the MPCs and determine the impact of any deviations on the technical usability of the data.	Data Validators, Tetra Tech	External

## 12.1 VALIDATION SUMMARY

<b>Analytical Group</b>	<b>Validation Criteria</b>	<b>Data Validator</b> (title and organizational affiliation)
VOC	A full (Level IV) data validation will be performed using criteria for SW-846 Method 8260B listed in this SAP and the current DoD QSM. If not included in the aforementioned, the logic outlined in Region 2 SOP HW-24 Validating VOCs by SW-846 Method 8260B (EPA, 2008) will be used to apply qualifiers to data to the extent possible.	Data Validation Specialist, Tetra Tech

## REFERENCES

B&RE (Brown and Root Environmental), 1996a. Remedial Investigation Report for Naval Weapons Station Earle, Colts Neck, New Jersey. Wayne, Pennsylvania. July.

B&RE, 1996b. Underground Storage Tank Phase I Remedial Investigation Report for Various Sites, Naval Weapons Station Earle, Colts Neck, New Jersey. Wayne, Pennsylvania. November.

B&RE, 1997. Focused Investigation and Remedial Action Work Plan for Buildings C-17/20/16/50, Naval Weapons Station Earle, Colts Neck, New Jersey. King of Prussia, Pennsylvania. September.

B&RE, 1998. Classification Exception Area Documentation for Buildings C-17/20/16/50, Naval Weapons Station Earle, Colts Neck, New Jersey. King of Prussia, Pennsylvania. May.

DoD (United States Department of Defense), 2010. *Department of Defense Quality Systems Manual for Environmental Laboratories*. Version 4.2. October.

ECOR (ECOR Solutions, Inc.), 2005. Year 7 Final Groundwater Monitoring Report for Remedial Action Implementation, Buildings C-17/20/16/50, Naval Weapons Station Earle, Colts Neck, New Jersey. West Chester, Pennsylvania. August.

ECOR, 2006. Year 8 Final Groundwater Monitoring Report for Remedial Action Implementation, Buildings C-17/20/16/50, Naval Weapons Station Earle, Colts Neck, New Jersey. West Chester, Pennsylvania. November.

ECOR, 2007. Final Year 9 Final Groundwater Monitoring Report for Remedial Action Implementation, Buildings C-17/20/16/50, Naval Weapons Station Earle, Colts Neck, New Jersey. West Chester, Pennsylvania. November.

ECOR, 2008. Final Year 10 Final Groundwater Monitoring Report for Remedial Action Implementation, Buildings C-17/20/16/50, Naval Weapons Station Earle, Colts Neck, New Jersey. West Chester, Pennsylvania. November.

ECOR, 2009. Final Year 11 Final Groundwater Monitoring Report for Remedial Action Implementation, Buildings C-17/20/16/50, Naval Weapons Station Earle, Colts Neck, New Jersey. West Chester, Pennsylvania. August.

## REFERENCES (Continued)

Enviro-Tech, 1995. Site Investigation Report for Site 16F (NWS Earle). November.

EPA (United States Environmental Protection Agency), 1999. *Contract Laboratory Program National Functional Guidelines for Organics Data Review*. EPA540/R-99/008. Office of Emergency and Remedial Response, Washington, DC. October.

EPA, 2002. Guidance for Quality Assurance Project Plans, EPA QA/G-5, EPA/240/R-02/009. Office of Environmental Information, Washington, DC. December.

EPA, 2005. Interagency Data Quality Task Force *Uniform Federal Policy for Quality Assurance Project Plans. Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs, Parts 1, 2A, 2B, and 2C*. EPA-505-B-04-900A, Final, Version 1. March.

EPA, 2006. Guidance on Systematic Planning Using the Data Quality Objectives Process. EPA QA/G-4, EPA/240/B-06/001. USEPA Office of Environmental Information, Washington DC. February.

EPA, 2008. Region 2 SOP HW-24. Validating Volatiles Organic Compounds by SW-846 Method 8260B. Revision 2. [http://www.epa.gov/Region2/qa/qa\\_documents/SOP%20HWSS-24.pdf](http://www.epa.gov/Region2/qa/qa_documents/SOP%20HWSS-24.pdf).

FWEC (Foster Wheeler Environmental Corporation/Earth Tech), 1999. UST Closure Report for Site 16F. Langhorne, Pennsylvania.

H&S (H & S Environmental, Inc.), 2010. Year 12 Groundwater Monitoring Report for Remedial Action Implementation for Buildings C-17/20/16/50, Naval Weapons Station Earle, Colts Neck, New Jersey. August.

H&S, 2011. Year 13 Groundwater Monitoring Report for Remedial Action Implementation for Buildings C-17/20/16/50, Naval Weapons Station Earle, Colts Neck, New Jersey. August.

NAVFAC ESC (Naval Facilities Engineering Service Center), 1996. Site Characterization and Analysis Penetrometer System (SCAPS), Site Characterization at Naval Weapons Station Earle, Colts Neck, New Jersey, Site 16/F. Site Specific Report SSR-2187-ENV. Port Hueneme, California. May.

NAVFAC ESC, 1999. Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program.

## **REFERENCES (Continued)**

NJDEP (New Jersey Department of Environmental Protection), 2005. Field Sampling Procedures Manual. March. <http://www.state.nj.us/dep/srp/guidance/fspm/>.

NJDEP, 2013a. Vapor Intrusion Technical Guidance. Version 3.1. March.

NJDEP, 2013b. NJDEP Master Table, Generic Vapor Intrusion Screening Levels, Table 1. N.J.A.C. 7:26E-1.15. March.

Tetra Tech (Tetra Tech, Inc.), 1999. Year 1 Groundwater Monitoring Report for Remedial Action Implementation, Buildings C-17/20/16/50, Naval Weapons Station Earle, Colts Neck, New Jersey. August.

Tetra Tech, 2000. Year 2 Groundwater Monitoring Report for Remedial Action Implementation, Buildings C-17/20/16/50, Naval Weapons Station Earle, Colts Neck, New Jersey. King of Prussia, Pennsylvania. July.

Tetra Tech, 2001. Year 3 Groundwater Monitoring Report for Remedial Action Implementation, Buildings C-17/20/16/50, Naval Weapons Station Earle, Colts Neck, New Jersey. King of Prussia, Pennsylvania.

Tetra Tech, 2002. Year 4 Groundwater Monitoring Report for Remedial Action Implementation, Buildings C-17/20/16/50, Naval Weapons Station Earle, Colts Neck, New Jersey. King of Prussia, Pennsylvania.

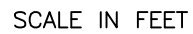
Tetra Tech, 2003. Year 5 Groundwater Monitoring Report for Remedial Action Implementation, Buildings C-17/20/16/50, Naval Weapons Station Earle, Colts Neck, New Jersey. King of Prussia, Pennsylvania.

Tetra Tech, 2004. Year 6 Groundwater Monitoring Report for Remedial Action Implementation, Buildings C-17/20/16/50, Naval Weapons Station Earle, Colts Neck, New Jersey. King of Prussia, Pennsylvania.

Tetra Tech, 2009. Bioslurper Optimization Report for LNAPL Recovery at Site 16/F - Buildings C-17/20/16/50, Naval Weapons Station Earle, Colts Neck, New Jersey. King of Prussia, Pennsylvania. September.

Weston (Roy F. Weston, Inc.), 1994. Installation Restoration Program Site Investigation for 16 Sites at NWS Earle, Colts Neck, New Jersey. January.

## FIGURES



**TETRA TECH**

MAINSIDE AREA LOCATION MAP  
NAVAL WEAPONS STATION EARLE  
COLTS NECK, NEW JERSEY

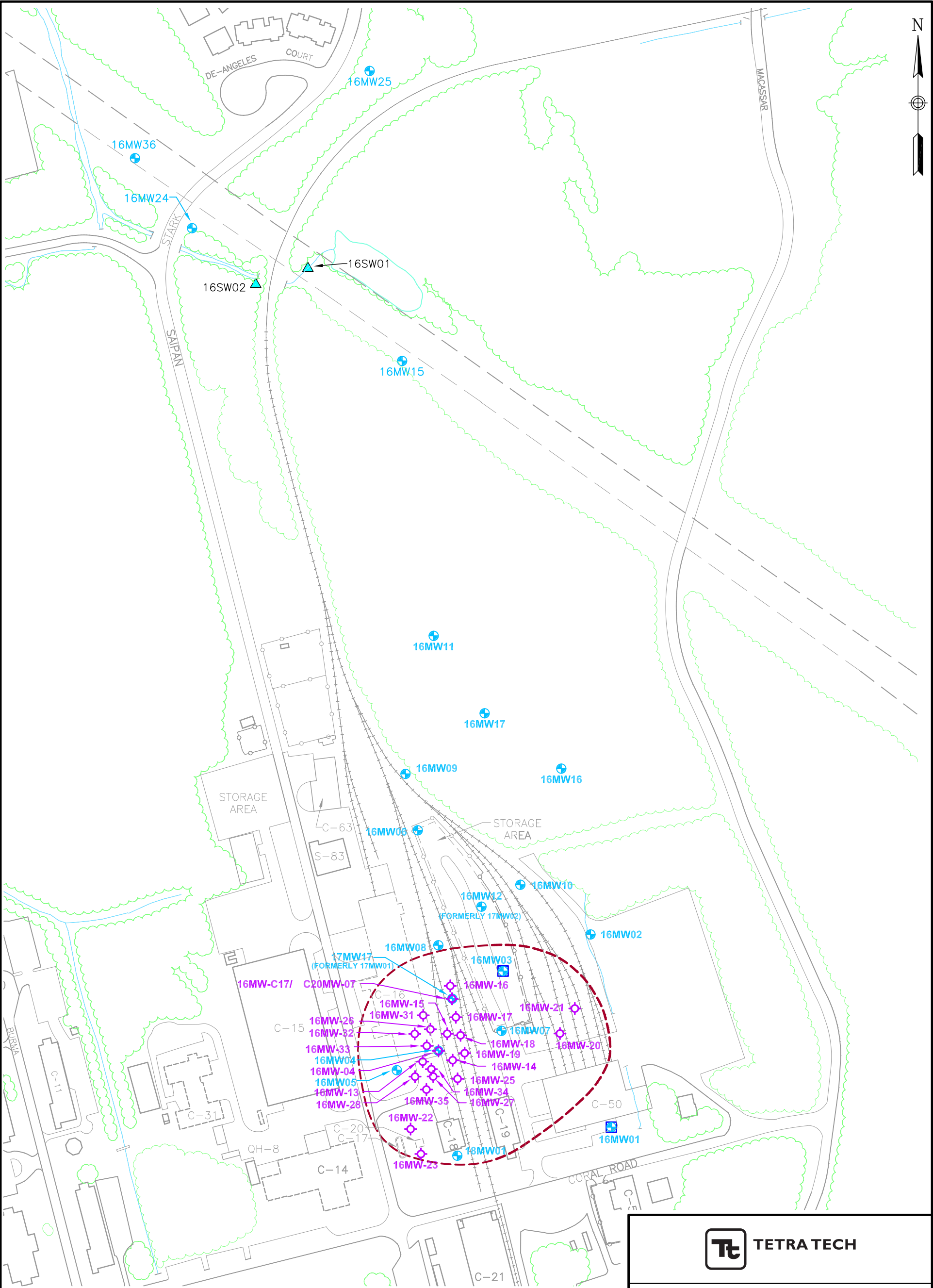
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AS NOTED

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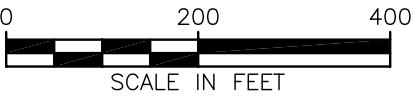
FIGURE 4-1





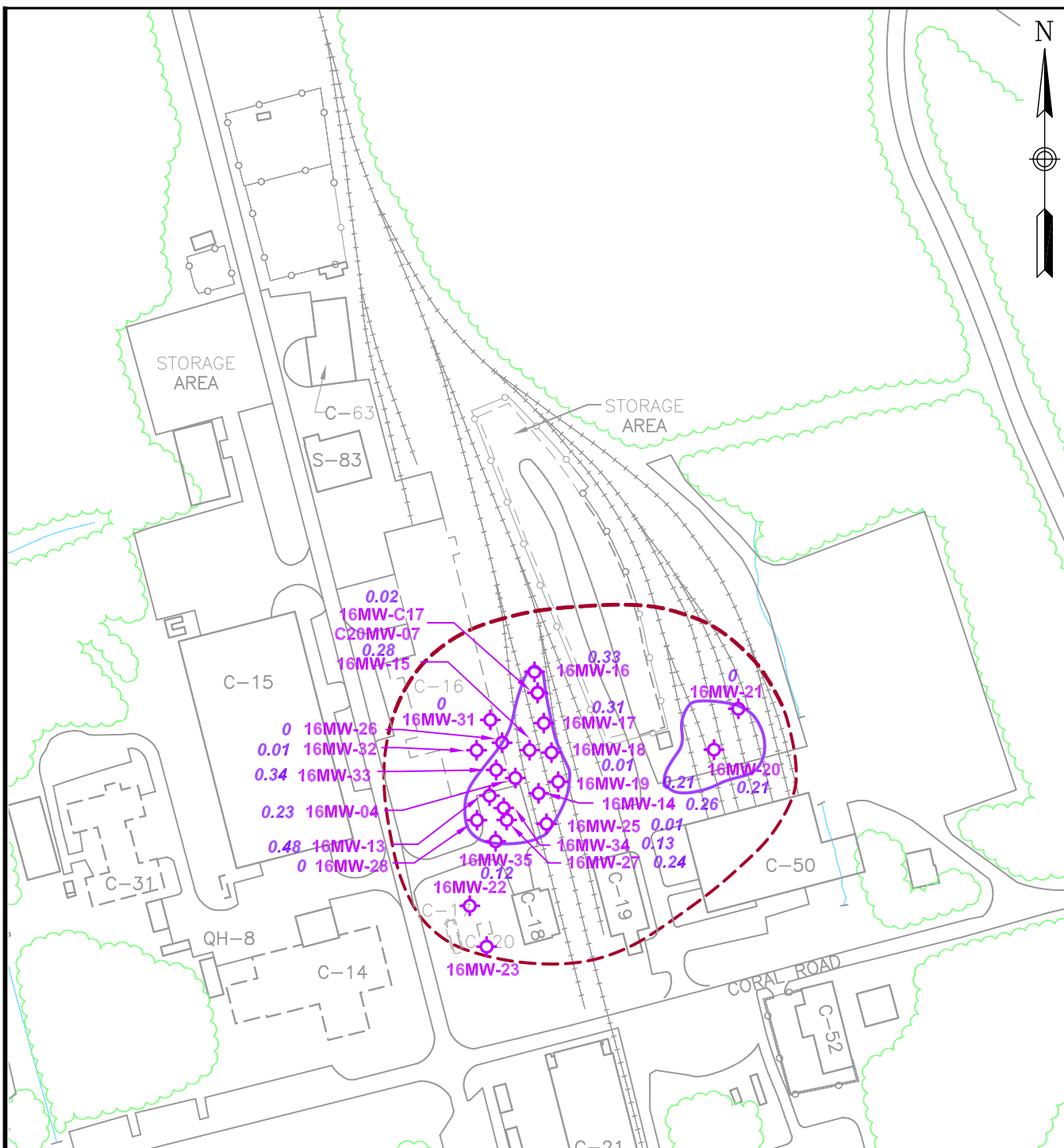
LEGEND

- MONITORING WELL LOCATION
- ABANDONED MONITORING WELL LOCATION
- BIOSLURPER RECOVERY WELL
- CEA BOUNDARY
- CURRENT BUILDING
- FORMER BUILDING LOCATION








SITE LAYOUT  
SITE 16/F – BUILDINGS 17/20/16/50  
NAVAL WEAPONS STATION  
COLTS NECK, NEW JERSEY

FILE 112G02091GM01	SCALE AS NOTED
FIGURE NUMBER FIGURE 4–2	REV 0
	DATE 08/02/12



## LEGEND

-  BIOSLURPER RECOVERY WELL      CEA BOUNDARY  
**0.13** LNAPL THICKNESS (FEET)      CURRENT BUILDING  
 LNAPL PLUME BOUNDARY BASED ON FORMER SCAPS STUDY      FORMER BUILDING LOCATION

0 200 400

SCALE IN FEET



**TETRA TECH**

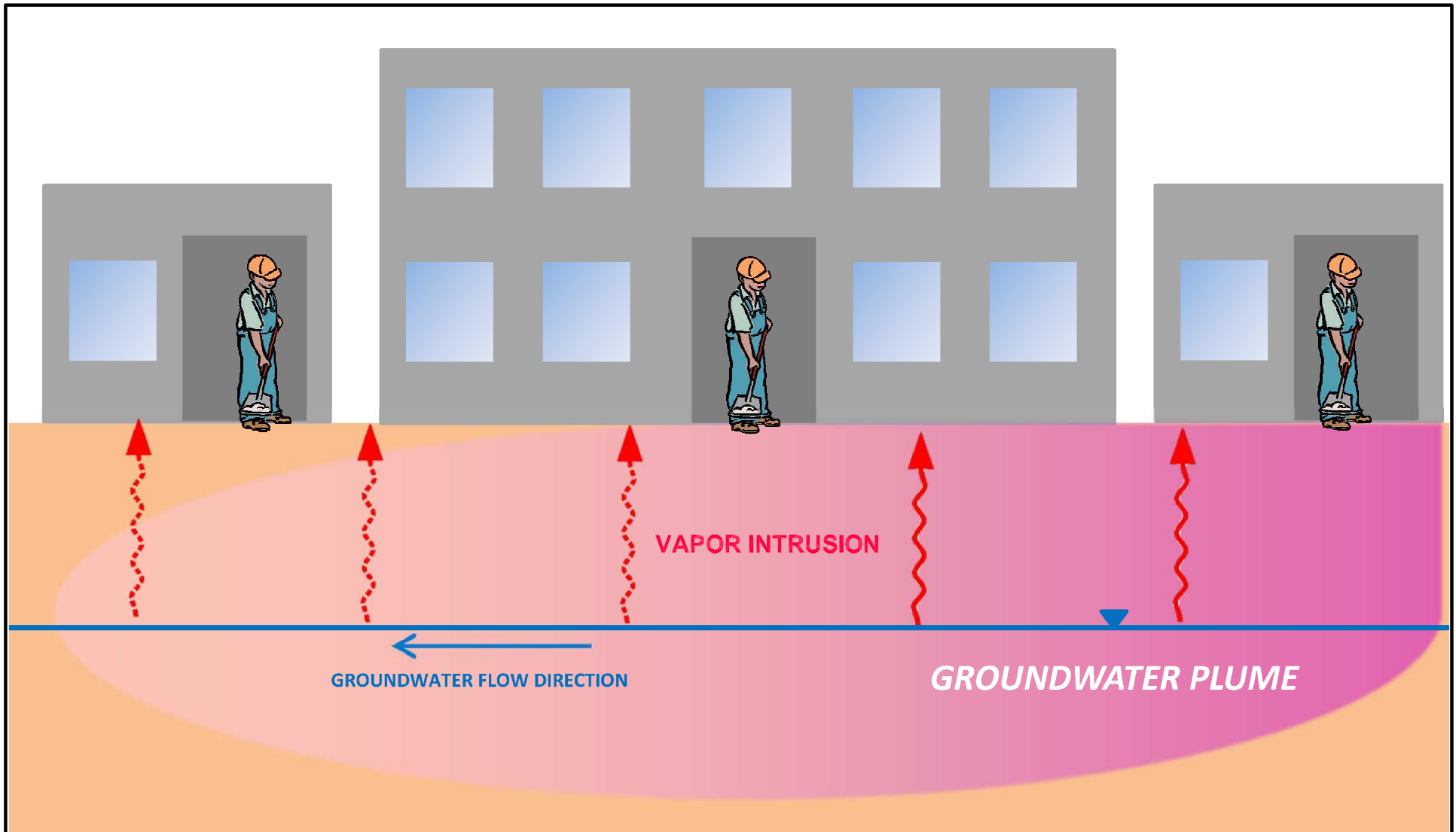
MAXIMUM LNAPL THICKNESS – JUNE 2011 TO MAY 2012  
SITE 16/F – BUILDINGS 17/20/16/50  
NAVAL WEAPONS STATION  
COLTS NECK, NEW JERSEY

SCALE  
AS NOTED

FILE  
112G02091GM02-3

REV	DATE
0	08/02/12

FIGURE 4-3



CONCEPTUAL SITE MODEL  
SITE 16/F – BUILDINGS 17/20/16/50  
NAVAL WEAPONS STATION EARLE  
COLTS NECK, NEW JERSEY

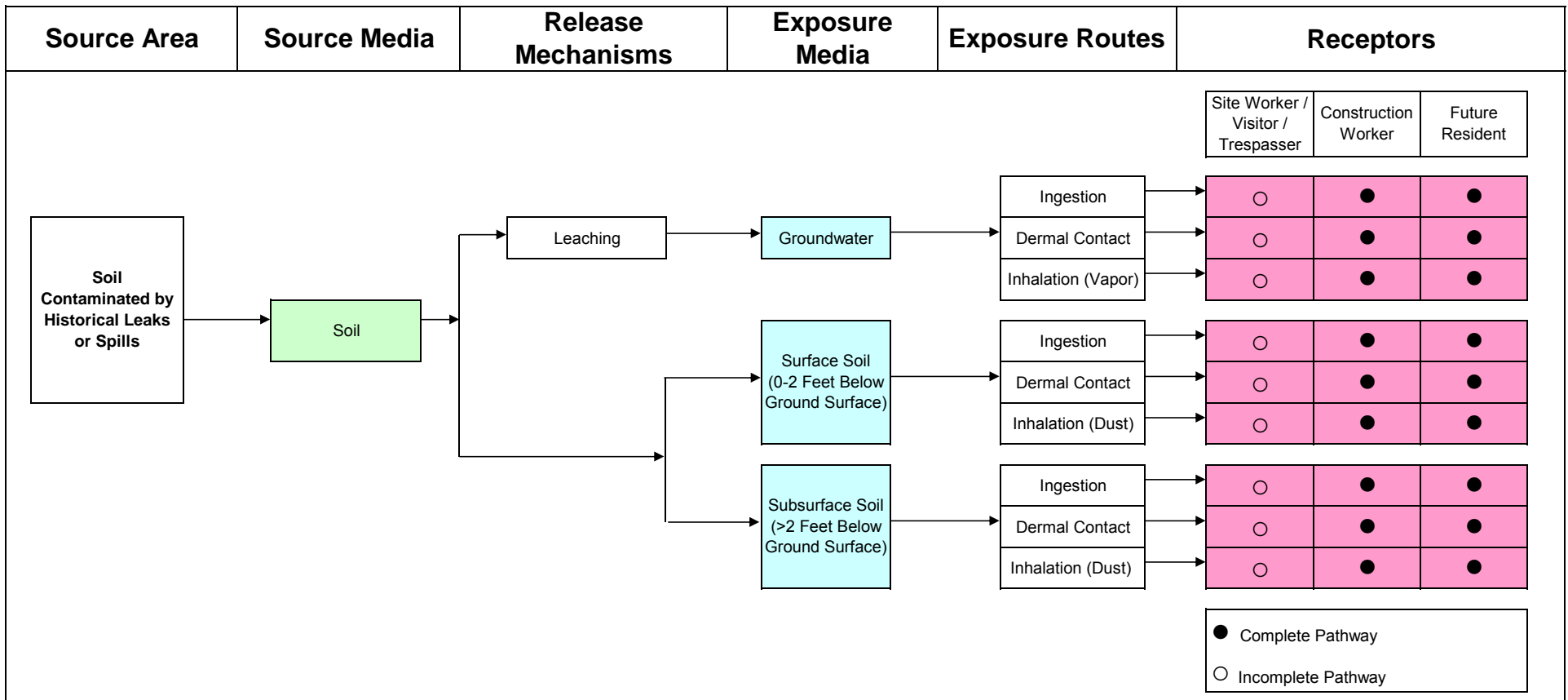
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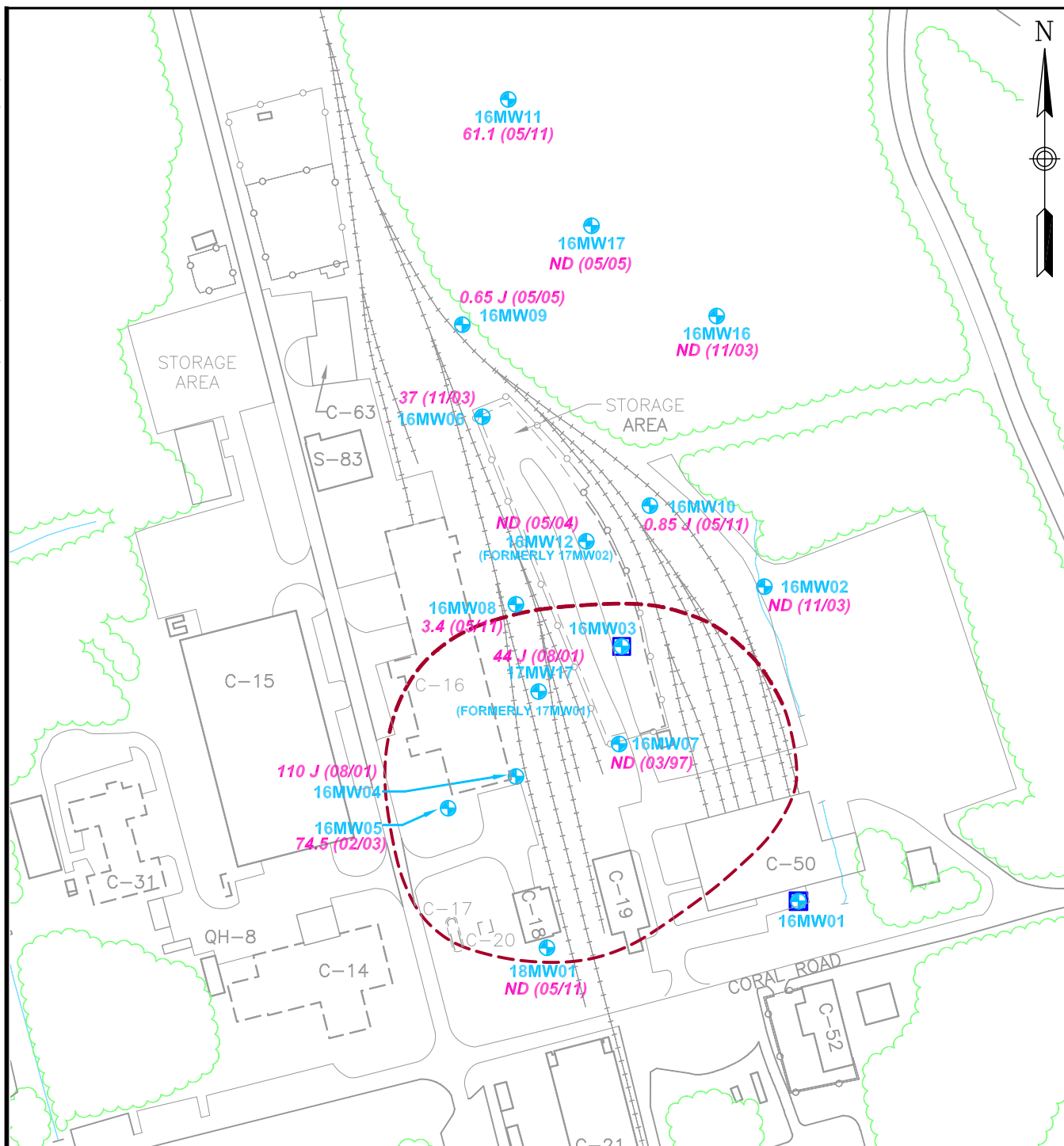
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REV DATE  
0 07/16/12

FIGURE NUMBER  
FIGURE 4-4

**FIGURE 4-5**  
**EXPOSURE PATHWAY ANALYSIS**  
**SITE 16/F**  
**NWS EARLE**  
**COLTS NECK, NEW JERSEY**





## LEGEND



MONITORING WELL LOCATION



ABANDONED MONITORING WELL LOCATION

--- CEA BOUNDARY

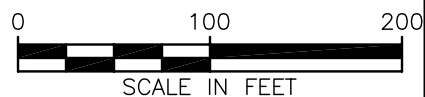


CURRENT BUILDING



FORMER BUILDING LOCATION

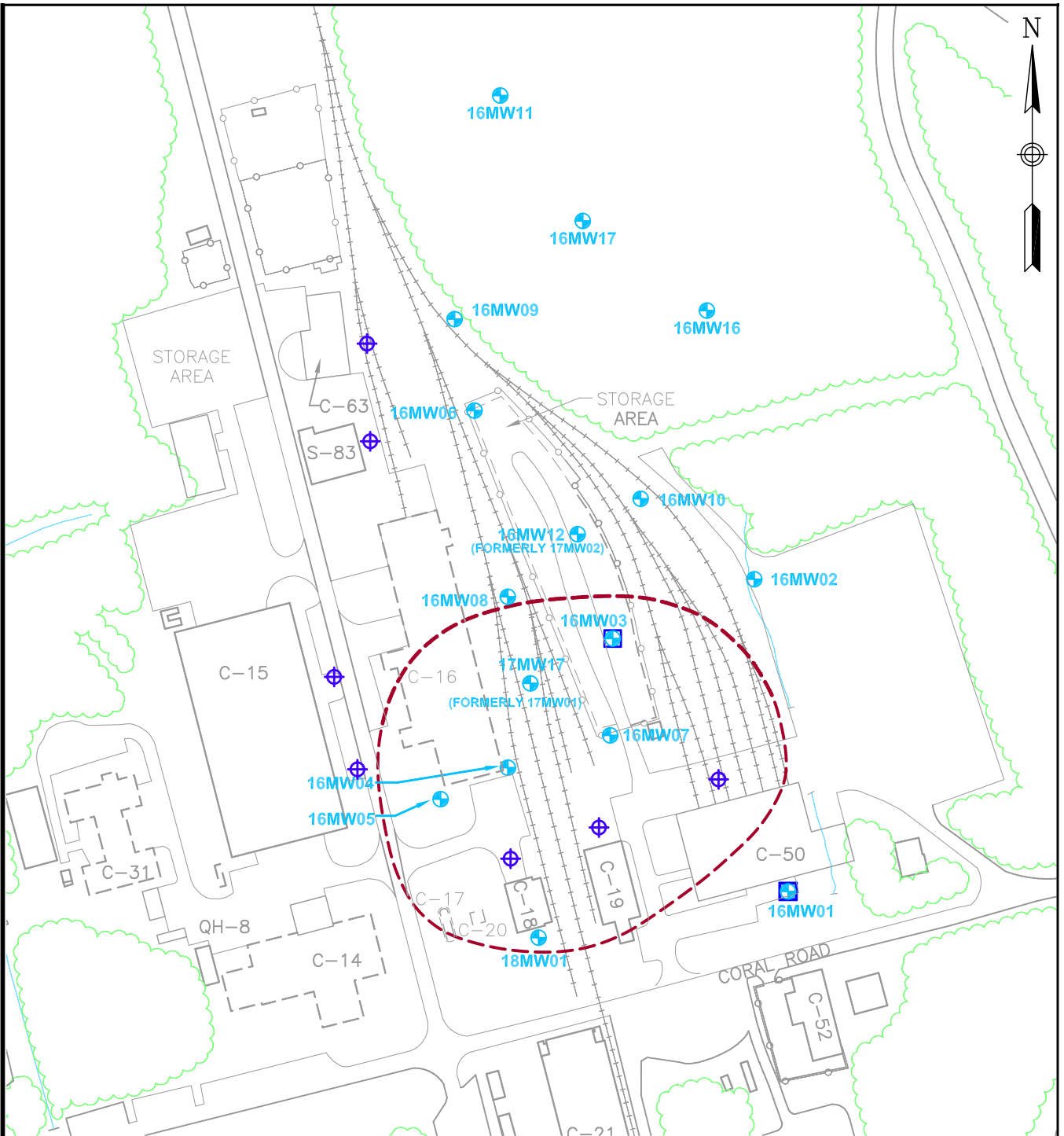
37 (11/03) BENZENE CONCENTRATION IN μg/L (DATE)



TETRA TECH

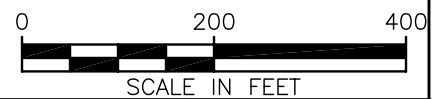
BENZENE CONCENTRATIONS IN GROUNDWATER  
SITE 16/F – BUILDINGS 17/20/16/50  
NAVAL WEAPONS STATION  
COLTS NECK, NEW JERSEY

SCALE  
AS NOTEDFILE  
112G02091GM02-2REV DATE  
0 08/02/12FIGURE NUMBER  
FIGURE 5-1



# LEGEND

- MONITORING WELL LOCATION
- ABANDONED MONITORING WELL LOCATION
- ⊕ PROPOSED GROUNDWATER SAMPLE LOCATION
- CEA BOUNDARY
- CURRENT BUILDING
- FORMER BUILDING LOCATION



TETRA TECH

PROPOSED GROUNDWATER SAMPLE LOCATION MAP  
SITE 16/F – BUILDINGS 17/20/16/50  
NAVAL WEAPONS STATION  
COLTS NECK, NEW JERSEY

SCALE AS NOTED	
FILE 112G02091GM02-1	
REV 0	DATE 08/02/12
FIGURE NUMBER FIGURE 7-1	

## **APPENDIX A**

### **TETRA TECH and NJDEP STANDARD OPERATING PROCEDURES**



**TETRA TECH**

# STANDARD OPERATING PROCEDURES

Number

CT-04

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Effective Date

01/2012

Revision

3

Applicability

Tetra Tech, Inc.

Prepared

Earth Sciences Department

Subject

SAMPLE NOMENCLATURE

Approved

J. Zimmerly

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## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to specify a consistent sample nomenclature system that will facilitate subsequent data management in a cost-effective manner. The sample nomenclature system has been devised such that the following objectives can be attained:

- Sorting of data by matrix
- Sorting of data by depth
- Maintenance of consistency (field, laboratory, and database sample numbers)
- Accommodation of all project-specific requirements
- Accommodation of laboratory sample number length constraints (maximum of 20 characters)

## 2.0 SCOPE

The methods described in this SOP shall be used consistently for all projects requiring electronic data. Other contract- or project-specific sample nomenclature requirements may also be applicable.

## 3.0 GLOSSARY

None.

## 4.0 RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS

**Program Manager** - It shall be the responsibility of the Project Manager (or designee) to inform contract-specific Project Managers (PMs) of the existence and requirements of this SOP.

**Project Manager** - It shall be the responsibility of the PM to determine the applicability of this SOP based on: (1) program-specific requirements and (2) project size and objectives. It shall be the responsibility of the PM (or designee) to ensure that sample nomenclature requirements are thoroughly specified in the relevant project planning document (e.g., sampling and analysis plan) and are consistent with this SOP if relevant. It shall be the responsibility of the PM to ensure that the FOL is familiar with the sample nomenclature system.

**Field Operations Leader (FOL)** - It shall be the responsibility of the FOL to ensure that all field technicians or sampling personnel are thoroughly familiar with this SOP and the project-specific sample nomenclature system. It shall be the responsibility of the FOL to ensure that the sample nomenclature system is used during all project-specific sampling efforts.

General personnel qualifications for sample nomenclature activities in the field include the following:

- Occupational Safety and Health Administration (OSHA) 40-hour and applicable refresher training.
- Capability of performing field work under the expected physical and environmental (i.e., weather) conditions.
- Familiarity with appropriate procedures for field documentation, handling, packaging, and shipping.

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## 5.0 PROCEDURES

### 5.1 INTRODUCTION

The sample identification (ID) system can consist of as few as eight but not more than 20 distinct alpha-numeric characters. The sample ID will be provided to the laboratory on the sample labels and chain-of-custody forms. The basic sample ID provided to the laboratory has three segments and shall be as follows, where "A" indicates "alpha," and "N" indicates "numeric":

<b>A or N 3 or 4 Characters</b>	<b>AAA 2 or 3 Characters</b>	<b>A or N 3 to 6 Characters</b>
Site Identifier	Sample Type	Sample Location

Additional segments may be added as needed. For example:

(1) Soil and sediment sample ID

<b>A or N 3 or 4 Characters</b>	<b>AAA 2 or 3 Characters</b>	<b>A or N 3 to 6 Characters</b>	<b>NNNN 4 Characters</b>
Site identifier	Sample type	Sample location	Sample depth

(2) Aqueous (groundwater or surface water) sample ID

<b>A or N 3 or 4 Characters</b>	<b>AAA 2 or 3 Characters</b>	<b>A or N 3 to 6 Characters</b>	<b>NN 2 Characters</b>	<b>-A 1 Character</b>
Site identifier	Sample type	Sample location	Round number	Filtered sample only

(3) Biota sample ID

<b>A or N 3 or 4 Characters</b>	<b>AAA 2 or 3 Characters</b>	<b>A or N 3 to 6 Characters</b>	<b>AA 2 Characters</b>	<b>NNN 3 Characters</b>
Site identifier	Sample type	Sample location	Species identifier	Sample group number

### 5.2 SAMPLE IDENTIFICATION FIELD REQUIREMENTS

The various fields in the sample ID include but are not limited to the following:

- Site identifier
- Sample type
- Sample location
- Sample depth
- Sampling round number
- Filtered
- Species identifier
- Sample group number

The site identifier must be a three- or four-character field (numeric characters, alpha characters, or a mixture of alpha and numeric characters may be used). A site number is necessary because many

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facilities/sites have multiple individual sites, Solid Waste Management Units (SWMUs), Operable Units (OUs), etc. Several examples are presented in Section 5.3 of this SOP.

The sample type must be a two- or three-character alpha field. Suggested codes are provided in Section 5.3 of this SOP.

The sample location must be at least a three-character field but may have up to six characters (alpha, numeric, or a mixture). The six characters may be useful in identifying a monitoring well to be sampled or describing a grid location.

The sample depth field is used to note the depth below ground surface (bgs) at which a soil or sediment sample is collected. The first two numbers of the four-number code specify the top interval, and the third and fourth specify the bottom interval in feet bgs of the sample. If the sample depth is equal to or greater than 100, then only the top interval would be represented and the sampling depth would be truncated to three characters. The depths will be noted in whole numbers only; further detail, if needed, will be recorded on the sample log sheet or boring log, in the logbook, etc.

A two-digit round number will be used to track the number of aqueous samples collected from a particular aqueous sample location. The first sample collected from a location will be assigned the round identifier 01, the second 02, etc. This applies to both existing and proposed monitoring wells and surface water locations.

Aqueous samples that are field filtered (dissolved analysis) will be identified with an "-F" in the last field segment. No entry in this segment signifies an unfiltered (total) sample.

The species identifier must be a two-character alpha field. Several suggested codes are provided in Section 5.3 of this SOP.

The three-digit sample group number will be used to track the number of biota sample groups (a particular group size may be determined by sample technique, media type, the number of individual caught, weight issues, time, etc.) by species and location. The first sample group of a particular species collected from a given location will be assigned the sample group number 001, and the second sample group of the same species collected from the same location will be assigned the sample group number 002.

### 5.3 **EXAMPLE SAMPLE FIELD DESIGNATIONS**

Examples of each of the fields are as follows:

Site identifier - Examples of site numbers/designations are as follows:

A01 - Area of Concern (AOC) 1  
125 - SWMU 125  
000 - Base- or facility-wide sample (e.g., upgradient well)  
BBG - Base background

The examples cited are only suggestions. Each PM (or designee) must designate appropriate (and consistent) site designations for their individual project.

Sample type - Examples of sample types are as follows:

AH - Ash Sample  
AS - Air Sample  
BM - Building Material Sample

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BSB	-	Biota Sample Full Body
BSF	-	Biota Sample Fillet
CP	-	Composite Sample
CS	-	Chip Sample
DS	-	Drum Sample
DU	-	Dust Sample
FP	-	Free Product
IDW	-	Investigation-Derived Waste Sample
LT	-	Leachate Sample
MW	-	Monitoring Well Groundwater Sample
OF	-	Outfall Sample
RW	-	Residential Well Sample
SB	-	Soil Boring Sample
SD	-	Sediment Sample
SC	-	Scrape Sample
SG	-	Soil Gas Sample
SL	-	Sludge Sample
SP	-	Seep Sample
SS	-	Surface Soil Sample
ST	-	Storm Sewer Water Sample
SW	-	Surface Water Sample
TP	-	Test Pit Sample
TW	-	Temporary Well Sample
WC	-	Well Construction Material Sample
WP	-	Wipe Sample
WS	-	Waste/Solid Sample
WW	-	Wastewater Sample

Sample location - Examples of the location field are as follows:

001	-	Monitoring well 1
N32E92	-	Grid location 32 North and 92 East
D096	-	Investigation-derived waste drum number 96

Species identifier - Examples of species identifier are as follows:

BC	-	Blue Crab
GB	-	Blue Gill
CO	-	Corn
SB	-	Soybean

#### 5.4 **EXAMPLES OF SAMPLE NOMENCLATURE**

The first round monitoring well groundwater sample collected from existing monitoring well 001 at SWMU 16 for a filtered sample would be designated as 016MW00101-F.

The second round monitoring well groundwater sample collected from existing monitoring well C20P2 at Site 23 for an unfiltered sample would be designated as 023MWC20P202.

The second surface water sample collected from point 01 at SWMU 130 for an unfiltered sample would be designated as 130SW00102.

A surface soil sample collected from grid location 32 North and 92 East at Site 32 at the 0- to 2-foot

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interval would be designated as 032SSN32E920002.

A subsurface soil sample from soil boring 03 at SWMU 32 at an interval of 4 to 5 feet bgs would be designated as 032SB0030405.

A sediment sample collected at SWMU 19 from 0 to 6 inches at location 14 would be designated as 019SD0140001. The sample data sheet would reflect the precise depth at which this sample was collected.

During biota sampling for full-body analysis, the first time a minnow trap was checked at grid location A25 of SWMU 1415, three small blue gills were captured, collected, and designated with the sample ID of 1415BSBA25BG001. The second time blue gill were collected at the same location (grid location A25 at SWMU 1415), the sample ID would be 1415BSBA25BG002.

Note: No dash (-) or spacing is used between the segments with the exception of the filtered segment. The "F" used for a filtered aqueous sample is preceded by a dash (-F).

## 5.5 FIELD QA/QC SAMPLE NOMENCLATURE

Field Quality Assurance (QA)/Quality Control (QC) samples are designated using a different coding system. The QC code will consist of a three- to four-segment alpha-numeric code that identifies the sample QC type, the date the sample was collected, and the number of this type of QC sample collected on that date.

AA	NNNNNN	NN	-F
QC type	Date	Sequence number (per day)	Filtered (aqueous only, if needed)

The QC types are identified as:

TB = Trip Blank

RB = Rinsate Blank (Equipment Blank)

FD = Field Duplicate

AB = Ambient Conditions Blank

WB = Source Water Blank

The sampling time recorded on the chain-of-custody form, labels, and tags for duplicate samples will be 0000 so that the samples are "blind" to the laboratory. Notes detailing the sample number, time, date, and type will be recorded on the routine sample log sheets and will document the location of the duplicate sample (sample log sheets are not provided to the laboratory). Documentation for all other QC types (TB, RB, AB, and WB) will be recorded on the QC Sample Log Sheet (see SOP SA-6.3, Field Documentation).

## 5.6 EXAMPLES OF FIELD QA/QC SAMPLE NOMENCLATURE

The first duplicate of the day for a filtered groundwater sample collected on June 3, 2000, would be designated as FD06030001-F.

The third duplicate of the day taken of a subsurface soil sample collected on November 17, 2003, would be designated as FD11170303.

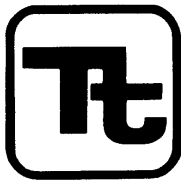
The first trip blank associated with samples collected on October 12, 2000, would be designated as TB10120001.

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The only rinsate blank collected on November 17, 2001, would be designated as RB11170101.

## 6.0 DEVIATIONS

Any deviation from this SOP must be addressed in detail in the site-specific planning documents.



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Tetra Tech, Inc.

Prepared

Health & Safety

Subject

UTILITY LOCATING AND EXCAVATION CLEARANCE

Approved

J. Zimmerly

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## 1.0 PURPOSE

Utilities such as electric service lines, natural or propane gas lines, water and sewage lines, telecommunications, and steam lines are very often in the immediate vicinity of work locations. Contact with underground or overhead utilities can have serious consequences including employee injury/fatality, property and equipment damage, substantial financial impacts, and loss of utility service to users.

The purpose of this procedure is to provide minimum requirements and technical guidelines regarding the appropriate procedures to be followed when performing subsurface and overhead utility locating services. It is the policy of Tetra Tech NUS, Inc. (TtNUS) to provide a safe and healthful work environment for the protection of our employees. The purpose of this Standard Operating Procedure (SOP) is to aid in achieving the objectives of this policy, to present the acceptable procedures pertaining to utility locating and excavation clearance activities, and to present requirements and restrictions relevant to these types of activities. This SOP must be reviewed by any employee potentially involved with underground or overhead utility locating and avoidance activities.

## 2.0 SCOPE

This procedure applies to all TtNUS field activities where there may be potential contact with underground or overhead utilities. This procedure provides a description of the principles of operation, instrumentation, applicability, and implementability of typical methods used to determine the presence and avoidance of contact with utility services. This procedure is intended to assist with work planning and scheduling, resource planning, field implementation, and subcontractor procurement. Utility locating and excavation clearance requires site-specific information prior to the initiation of any such activities on a specific project. This SOP is not intended to provide a detailed description of methodology and instrument operation. Specialized expertise during both planning and execution of several of the methods presented may also be required.

## 3.0 GLOSSARY

Electromagnetic Induction (EMI) Survey - A geophysical exploration method whereby electromagnetic fields are induced in the ground and the resultant secondary electromagnetic fields are detected as a measure of ground conductivity.

Magnetometer – A device used for precise and sensitive measurements of magnetic fields.

Magnetic Survey – A geophysical survey method that depends on detection of magnetic anomalies caused by the presence of buried ferromagnetic objects.

Metal Detection – A geophysical survey method that is based on electromagnetic coupling caused by underground conductive objects.

Vertical Gradiometer – A magnetometer equipped with two sensors that are vertically separated by a fixed distance. It is best suited to map near surface features and is less susceptible to deep geologic features.

Ground Penetrating Radar – Ground Penetrating Radar (GPR) involves specialized radar equipment whereby a signal is sent into the ground via a transmitter. Some portion of the signal will be reflected from the subsurface material, which is then recorded with a receiver and electronically converted into a graphic picture.



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#### 4.0 RESPONSIBILITIES

Project Manager (PM)/Task Order Manager (TOM) - Responsible for ensuring that all field activities are conducted in accordance with this procedure.

Site Manager (SM)/Field Operations Leader (FOL) - Responsible for the onsite verification that all field activities are performed in compliance with approved SOPs or as otherwise directed by the approved project plan(s).

Site Health & Safety Officer (SHSO) – Responsible to provide technical assistance and verify full compliance with this SOP. The SHSO is also responsible for reporting any deficiencies to the Corporate Health and Safety Manager (HSM) and to the PM/TOM.

Health & Safety Manager (HSM) – Responsible for preparing, implementing, and modifying corporate health and safety policy and this SOP.

Site Personnel – Responsible for performing their work activities in accordance with this SOP and the TtNUS Health and Safety Policy.

#### 5.0 PROCEDURES

This procedure addresses the requirements and technical procedures that must be performed to minimize the potential for contact with underground and overhead utility services. These procedures are addressed individually from a buried and overhead standpoint.

##### 5.1 Buried Utilities

Buried utilities present a heightened concern because their location is not typically obvious by visual observation, and it is common that their presence and/or location is unknown or incorrectly known on client properties. This procedure must be followed prior to beginning any subsurface probing or excavation that might potentially be in the vicinity of underground utility services. In addition, the Utility Clearance Form (Attachment 3) must be completed for every location or cluster of locations where intrusive activities will occur.

Where the positive identification and de-energizing of underground utilities cannot be obtained and confirmed using the following steps, the PM/TOM is responsible for arranging for the procurement of a qualified, experienced, utility locating subcontractor who will accomplish the utility location and demarcation duties specified herein.

1. A comprehensive review must be made of any available property maps, blue lines, or as-builts prior to site activities. Interviews with local personnel familiar with the area should be performed to provide additional information concerning the location of potential underground utilities. Information regarding utility locations shall be added to project maps upon completion of this exercise.
- 2., A visual site inspection must be performed to compare the site plan information to actual field conditions. Any findings must be documented and the site plan/maps revised. The area(s) of proposed excavation or other subsurface activities must be marked at the site in white paint or pin flags to identify those locations of the proposed intrusive activities. The site inspection should focus on locating surface indications of potential underground utilities. Items of interest include the presence of nearby area lights, telephone service, drainage grates, fire hydrants, electrical service vaults/panels, asphalt/concrete scares and patches, and topographical depressions. Note the location of any emergency shut off switches. Any additional information regarding utility

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locations shall be added to project maps upon completion of this exercise and returned to the PM/TOM.

3. If the planned work is to be conducted on private property (e.g., military installations, manufacturing facilities, etc.) the FOL must identify and contact appropriate facility personnel (e.g., public works or facility engineering) before any intrusive work begins to inquire about (and comply with) property owner requirements. It is important to note that private property owners may require several days to several weeks advance notice prior to locating utilities.
4. If the work location is on public property, the state agency that performs utility clearances must be notified (see Attachment 1). State "one-call" services must be notified prior to commencing fieldwork per their requirements. Most one-call services require, by law, 48- to 72-hour advance notice prior to beginning any excavation. Such services typically assign a "ticket" number to the particular site. This ticket number must be recorded for future reference and is valid for a specific period of time, but may be extended by contacting the service again. The utility service will notify utility representatives who then mark their respective lines within the specified time frame. It should be noted that most military installations own their own utilities but may lease service and maintenance from area providers. Given this situation, "one call" systems may still be required to provide location services on military installations.
5. Utilities must be identified and their locations plainly marked using pin flags, spray paint, or other accepted means. The location of all utilities must be noted on a field sketch for future inclusion on project maps. Utility locations are to be identified using the following industry-standard color code scheme, unless the property owner or utility locator service uses a different color code:

white	excavation/subsurface investigation location
red	electrical
yellow	gas, oil, steam
orange	telephone, communications
blue	water, irrigation, slurry
green	sewer, drain
6. Where utility locations are not confirmed with a high degree of confidence through drawings, schematics, location services, etc., the work area must be thoroughly investigated prior to beginning the excavation. In these situations, utilities must be identified using safe and effective methods such as passive and intrusive surveys, or the use of non-conductive hand tools. Also, in situations where such hand tools are used, they should always be used in conjunction with suitable detection equipment, such as the items described in Section 6.0 of this SOP. Each method has advantages and disadvantages including complexity, applicability, and price. It also should be noted that in some states, initial excavation is required by hand to a specified depth.
7. At each location where trenching or excavating will occur using a backhoe or other heavy equipment, and where utility identifications and locations cannot be confirmed prior to groundbreaking, the soil must be probed using a device such as a tile probe which is made of non-conductive material such as fiberglass. If these efforts are not successful in clearing the excavation area of suspect utilities, hand shoveling must be performed for the perimeter of the intended excavation.
8. All utilities uncovered or undermined during excavation must be structurally supported to prevent potential damage. Unless necessary as an emergency corrective measure, TtNUS shall not make any repairs or modifications to existing utility lines without prior permission of the utility owner, property owner, and Corporate HSM. All repairs require that the line be locked-out/tagged-out prior to work.

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## 5.2 Overhead Power Lines

If it is necessary to work within the minimum clearance distance of an overhead power line, the overhead line must be de-energized and grounded, or re-routed by the utility company or a registered electrician. If protective measures such as guarding, isolating, or insulating are provided, these precautions must be adequate to prevent employees from contacting such lines directly with any part of their body or indirectly through conductive materials, tools, or equipment.

The following table provides the required minimum clearances for working in proximity to overhead power lines.

<u>Nominal Voltage</u>	<u>Minimum Clearance</u>
0 -50 kV	10 feet, or one mast length; whichever is greater
50+ kV	10 feet plus 4 inches for every 10 kV over 50 kV or 1.5 mast lengths; whichever is greater

## 6.0 UNDERGROUND LOCATING TECHNIQUES

A variety of supplemental utility locating approaches are available and can be applied when additional assurance is needed. The selection of the appropriate method(s) to employ is site-specific and should be tailored to the anticipated conditions, site and project constraints, and personnel capabilities.

### 6.1 Geophysical Methods

Geophysical methods include electromagnetic induction, magnetics, and ground penetrating radar. Additional details concerning the design and implementation of electromagnetic induction, magnetics, and ground penetrating radar surveys can be found in one or more of the TtNUS SOPs included in the References (Section 8.0).

#### **Electromagnetic Induction**

Electromagnetic Induction (EMI) line locators operate either by locating a background signal or by locating a signal introduced into the utility line using a transmitter. A utility line acts like a radio antenna, producing electrons, which can be picked up with a radiofrequency receiver. Electrical current carrying conductors have a 60HZ signal associated with them. This signal occurs in all power lines regardless of voltage. Utilities in close proximity to power lines or used as grounds may also have a 60HZ signal, which can be picked up with an EM receiver. A typical example of this type of geophysical equipment is an EM-61.

EMI locators specifically designed for utility locating use a special signal that is either indirectly induced onto a utility line by placing the transmitter above the line or directly induced using an induction clamp. The clamp induces a signal on the specific utility and is the preferred method of tracing since there is little chance of the resulting signals being interfered with. A good example of this type of equipment is the Schonstedt® MAC-51B locator. The MAC-51B performs inductively traced surveys, simple magnetic locating, and traced nonmetallic surveys.

When access can be gained inside a conduit to be traced, a flexible insulated trace wire can be used. This is very useful for non-metallic conduits but is limited by the availability of gaining access inside the pipe.

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## **Magnetics**

Magnetic locators operate by detecting the relative amounts of buried ferrous metal. They are incapable of locating or identifying nonferrous utility lines but can be very useful for locating underground storage tanks (UST's), steel utility lines, and buried electrical lines. A typical example of this type of equipment is the Schonstedt® GA-52Cx locator. The GA-52Cx is capable of locating 4-inch steel pipe up to 8 feet deep.

Non-ferrous lines are often located by using a typical plumbing tool (snake) fed through the line. A signal is then introduced to the snake that is then traced.

## **Ground Penetrating Radar**

Ground Penetrating Radar (GPR) involves specialized radar equipment whereby a signal is sent into the ground via a transmitter. Some portion of the signal will be reflected from the subsurface material, which is then recorded with a receiver and electronically converted into a graphic picture. In general, an object which is harder than the surrounding soil will reflect a stronger signal. Utilities, tunnels, UST's, and footings will reflect a stronger signal than the surrounding soil. Although this surface detection method may determine the location of a utility, this method does not specifically identify utilities (i.e., water vs. gas, electrical vs. telephone); hence, verification may be necessary using other methods. This method is somewhat limited when used in areas with clay soil types or with a high water table.

## **6.2 Passive Detection Surveys**

### **Acoustic Surveys**

Acoustic location methods are generally most applicable to waterlines or gas lines. A highly sensitive Acoustic Receiver listens for background sounds of water flowing (at joints, leaks, etc.) or to sounds introduced into the water main using a transducer. Acoustics may also be applicable to determine the location of plastic gas lines.

### **Thermal Imaging**

Thermal (i.e., infrared) imaging is a passive method for detecting the heat emitted by an object. Electronics in the infrared camera convert subtle heat differentials into a visual image on the viewfinder or a monitor. The operator does not look for an exact temperature; rather they look for heat anomalies (either elevated or suppressed temperatures) characteristic of a potential utility line.

The thermal fingerprint of underground utilities results from differences in temperature between the atmosphere and the fluid present in a pipe or the heat generated by electrical resistance. In addition, infrared scanners may be capable of detecting differences in the compaction, temperature and moisture content of underground utility trenches. High-performance thermal imagery can detect temperature differences to hundredths of a degree.

## **6.3 Intrusive Detection Surveys**

### **Vacuum Excavation**

Vacuum excavation is used to physically expose utility services. The process involves removing the surface material over approximately a 1' x 1' area at the site location. The air-vacuum process proceeds with the simultaneous action of compressed air-jets to loosen soil and vacuum extraction of the resulting

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debris. This process ensures the integrity of the utility line during the excavation process, as no hammers, blades, or heavy mechanical equipment comes into contact with the utility line, eliminating the risk of damage to utilities. The process continues until the utility is uncovered. Vacuum excavation can be used at the proposed site location to excavate below the "utility window" which is usually 8 feet.

### **Hand Excavation**

When the identification and location of underground utilities cannot be positively confirmed through document reviews and/or other methods, borings and excavations may be cleared via the use of non-conductive hand tools. This should always be done in conjunction with the use of detection equipment. This would be required for all locations where there is a potential to impact buried utilities. The minimum hand-excavation depth that must be reached is to be determined considering the geographical location of the work site. This approach recognizes that the placement of buried utilities is influenced by frost line depths that vary by geographical region. Attachment 2 presents frost line depths for the regions of the contiguous United States. At a minimum, hand excavation depths must be at least to the frost line depth (see Attachment 2) plus two (2) feet, but never less than 4 feet below ground surface (bgs). For hand excavation, the hole created must be reamed large enough to be at least the diameter of the drill rig auger or bit prior to drilling. For soil gas surveys, the survey probe shall be placed as close as possible to the cleared hand excavation. It is important to note that a post-hole digger must not be used in this type of hand excavation activity.

### **Tile Probe Surveys**

For some soil types, site conditions, and excavation requirements, non-conductive tile probes may be used. A tile probe is a "T"-handled rod of varying lengths that can be pushed into the soil to determine if any obstructions exist at that location. Tile probes constructed of fiberglass or other nonconductive material are readily-available from numerous vendors. Tile probes must be performed to the same depth requirements as previously specified. As with other types of hand excavating activities, the use of a non-conductive tile probe, should always be in conjunction with suitable utility locating detection equipment.

## **7.0 INTRUSIVE ACTIVITIES SUMMARY**

The following list summarizes the activities that must be performed prior to beginning subsurface activities:

1. Map and mark all subsurface locations and excavation boundaries using white paint or markers specified by the client or property owner.
2. Notify the property owner and/or client that the locations are marked. At this point, drawings of locations or excavation boundaries shall be provided to the property owner and/or client so they may initiate (if applicable) utility clearance.

Note: Drawings with confirmed locations should be provided to the property owner and/or client as soon as possible to reduce potential time delays.

3. Notify "One Call" service. If possible, arrange for an appointment to show the One Call representative the surface locations or excavation boundaries in person. This will provide a better location designation to the utilities they represent. You should have additional drawings should you need to provide plot plans to the One Call service.
4. Implement supplemental utility detection techniques as necessary and appropriate to conform utility locations or the absence thereof.

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5. Complete Attachment 3, Utility Clearance Form. This form should be completed for each excavation location. In situations where multiple subsurface locations exist within the close proximity of one another, one form may be used for multiple locations provided those locations are noted on the Utility Clearance Form. Upon completion, the Utility Clearance Form and revised/annotated utility location map becomes part of the project file.

## 8.0 REFERENCES

OSHA Letter of Interpretation, Mr. Joseph Caldwell, Attachment 4  
 OSHA 29 CFR 1926(b)(2)  
 OSHA 29 CFR 1926(b)(3)  
 Tt Utility Locating and Clearance Policy  
 Tt SOP GH-3.1; Resistivity and Electromagnetic Induction  
 Tt SOP GH-3.2; Magnetic and Metal Detection Surveys  
 Tt SOP GH-3.4; Ground-penetrating Radar Surveys

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## ATTACHMENT 1 LISTING OF UNDERGROUND UTILITY CLEARANCE RESOURCES



**American Public Works Association**  
 2345 Grand Boulevard, Suite 500, Kansas City, MO 64108-2625  
 Phone (816) 472-6100 • Fax (816) 472-1610  
 Web [www.apwa.net](http://www.apwa.net) • E-mail [apwa@apwa.net](mailto:apwa@apwa.net)

### ONE-CALL SYSTEMS INTERNATIONAL CONDENSED DIRECTORY

<b>Alabama</b> Alabama One-Call 1-800-292-8525	<b>Iowa</b> Iowa One-Call 1-800-292-8989	<b>New Jersey</b> New Jersey One Call 1-800-272-1000
<b>Alaska</b> Locate Call Center of Alaska, Inc. 1-800-478-3121	<b>Kansas</b> Kansas One-Call System, Inc. 1-800-344-7233	<b>New Mexico</b> New Mexico One Call System, Inc. 1-800-321-2537 Las Cruces- Dona Ana Blue Stakes 1-888-526-0400
<b>Arizona</b> Arizona Blue Stake 1-800-782-5348	<b>Kentucky</b> Kentucky Underground Protection Inc. 1-800-752-6007	<b>New York</b> Dig Safely New York 1-800-962-7962 New York City- Long Island One Call Center 1-800-272-4480
<b>Arkansas</b> Arkansas One Call System, Inc. 1-800-482-8998	<b>Louisiana</b> Louisiana One Call System, Inc. 1-800-272-3020	<b>North Carolina</b> The North Carolina One-Call Center, Inc. 1-800-632-4949
<b>California</b> Underground Service Alert North 1-800-227-2600 Underground Service Alert of Southern California 1-800-227-2600	<b>Maine</b> Dig Safe System, Inc. 1-888-344-7233	<b>North Dakota</b> North Dakota One-Call 1-800-795-0555
<b>Colorado</b> Utility Notification Center of Colorado 1-800-922-1987	<b>Maryland</b> Miss Utility 1-800-257-7777 Miss Utility of Delmarva 1-800-282-8555	<b>Ohio</b> Ohio Utilities Protection Service 1-800-362-2764 Oil & Gas Producers Underground Protect'n Svc 1-800-925-0988
<b>Connecticut</b> Call Before You Dig 1-800-922-4455	<b>Massachusetts</b> Dig Safe System, Inc. 1-888-344-7233	<b>Oklahoma</b> Call Okie 1-800-522-6543
<b>Delaware</b> Miss Utility of Delmarva 1-800-282-8555	<b>Michigan</b> Miss Dig System, Inc. 1-800-482-7171	<b>Oregon</b> Oregon Utility Notification Center/One Call Concepts 1-800-332-2344
<b>Florida</b> Sunshine State One-Call of Florida, Inc. 1-800-432-4770	<b>Minnesota</b> Gopher State One Call 1-800-252-1166	<b>Pennsylvania</b> Pennsylvania One Call System, Inc. 1-800-242-1776
<b>Georgia</b> Underground Protection Center, Inc. 1-800-282-7411	<b>Mississippi</b> Mississippi One-Call System, Inc. 1-800-227-6477	<b>Rhode Island</b> Dig Safe System, Inc. 1-888-344-7233
<b>Hawaii</b> Underground Service Alert North 1-800-227-2600	<b>Missouri</b> Missouri One-Call System, Inc. 1-800-344-7483	<b>South Carolina</b> Palmetto Utility Protection Service Inc. 1-888-721-7877
<b>Idaho</b> Dig Line Inc. 1-800-342-1585 Kootenai County One-Call 1-800-428-4950 Shoshone - Benewah One-Call 1-800-398-3285	<b>Montana</b> Utilities Underground Protection Center 1-800-424-5555 Montana One Call Center 1-800-551-8344	<b>South Dakota</b> South Dakota One Call 1-800-781-7474
<b>Illinois</b> JULIE, Inc. 1-800-892-0123 Digger (Chicago Utility Alert Network) 312-744-7000	<b>Nebraska</b> Diggers Hotline of Nebraska 1-800-331-5666	<b>Tennessee</b> Tennessee One-Call System, Inc. 1-800-351-1111
<b>Indiana</b> Indiana Underground Plant Protection Service 1-800-382-5544	<b>Nevada</b> Underground Service Alert North 1-800-227-2600	
	<b>New Hampshire</b> Dig Safe System, Inc. 1-888-344-7233	

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### ATTACHMENT 1 (Continued)

**Texas**

Texas One Call System  
1-800-245-4545  
Texas Excavation Safety System, Inc.  
1-800-344-8377  
Lone Star Notification Center  
1-800-669-8344

**Utah**

Blue Stakes of Utah  
1-800-662-4111

**Vermont**

Dig Safe System, Inc.  
1-888-344-7233

**Virginia**

Miss Utility of Virginia  
1-800-552-7001  
Miss Utility (Northern Virginia)  
1-800-257-7777

**Washington**

Utilities Underground Location Center  
1-800-424-5555  
Northwest Utility Notification Center  
1-800-553-4344  
Inland Empire Utility Coordinating  
Council  
509-456-8000

**West Virginia**

Miss Utility of West Virginia, Inc.  
1-800-245-4848

**Wisconsin**

Diggers Hotline, Inc.  
1-800-242-8511

**Wyoming**

Wyoming One-Call System, Inc.  
1-800-348-1030  
Call Before You Dig of Wyoming  
1-800-849-2476

**District of Columbia**

Miss Utility  
1-800-257-7777

**Alberta**

Alberta One-Call Corporation  
1-800-242-3447

**British Columbia**

BC One Call  
1-800-474-6886

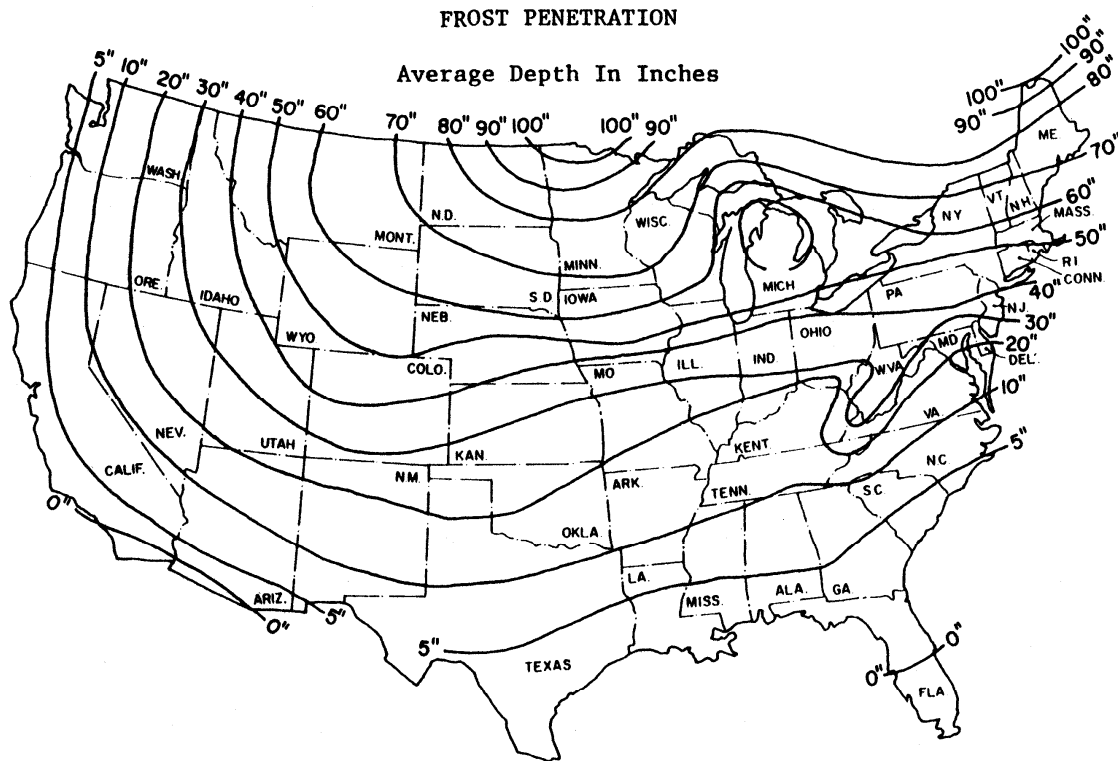
**Ontario**

Ontario One-Call System  
1-800-400-2255

**Quebec**

Info-Excavation  
1-800-663-9228



**ATTACHMENT 2****FROST LINE PENETRATION DEPTHS BY GEOGRAPHIC LOCATION**

Courtesy U.S. Department Of Commerce

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**ATTACHMENT 3  
UTILITY CLEARANCE FORM**

Client: \_\_\_\_\_ Project Name: \_\_\_\_\_  
 Project No.: \_\_\_\_\_ Completed By: \_\_\_\_\_  
 Location Name: \_\_\_\_\_ Work Date: \_\_\_\_\_  
 Excavation Method/Overhead Equipment: \_\_\_\_\_

1. Underground Utilities Circle One
- a) Review of existing maps? yes no N/A
- b) Interview local personnel? yes no N/A
- c) Site visit and inspection? yes no N/A
- d) Excavation areas marked in the field? yes no N/A
- e) Utilities located in the field? yes no N/A
- f) Located utilities marked/added to site maps? yes no N/A
- g) Client contact notified yes no N/A  
 Name \_\_\_\_\_ Telephone: \_\_\_\_\_ Date: \_\_\_\_\_
- g) State One-Call agency called? yes no N/A  
 Caller: \_\_\_\_\_  
 Ticket Number: \_\_\_\_\_ Date: \_\_\_\_\_
- h) Geophysical survey performed? yes no N/A  
 Survey performed by: \_\_\_\_\_  
 Method: \_\_\_\_\_ Date: \_\_\_\_\_
- i) Hand excavation performed (with concurrent use of utility yes no N/A  
 detection device)?  
 Completed by: \_\_\_\_\_  
 Total depth: \_\_\_\_\_ feet Date: \_\_\_\_\_
- j) Trench/excavation probed? yes no N/A  
 Probing completed by: \_\_\_\_\_  
 Depth/frequency: \_\_\_\_\_ Date: \_\_\_\_\_
2. Overhead Utilities Present Absent
- a) Determination of nominal voltage yes no N/A
- b) Marked on site maps yes no N/A
- c) Necessary to lockout/insulate/re-route yes no N/A
- d) Document procedures used to lockout/insulate/re-route yes no N/A
- e) Minimum acceptable clearance (SOP Section 5.2): \_\_\_\_\_

3. Notes: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Approval:

\_\_\_\_\_  
 Site Manager/Field Operations Leader

\_\_\_\_\_  
 Date

c: PM/Project File  
 Program File

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## ATTACHMENT 4 OSHA LETTER OF INTERPRETATION

Mr. Joseph Caldwell  
Consultant  
Governmental Liaison  
Pipeline Safety Regulations  
211 Wilson Boulevard  
Suite 700  
Arlington, Virginia 22201

Re: Use of hydro-vacuum or non-conductive hand tools to locate underground utilities.

Dear Mr. Caldwell:

In a letter dated July 7, 2003, we responded to your inquiry of September 18, 2002, regarding the use of hydro-vacuum equipment to locate underground utilities by excavation. After our letter to you was posted on the OSHA website, we received numerous inquiries that make it apparent that aspects of our July 7 letter are being misunderstood. In addition, a number of industry stakeholders, including the National Utility Contractors Association (NUCA), have provided new information regarding equipment that is available for this work.

To clarify these issues, we are withdrawing our July 7 letter and issuing this replacement response to your inquiry.

***Question:*** Section 1926.651 contains several requirements that relate to the safety of employees engaged in excavation work. Specifically, paragraphs (b)(2) and (b)(3) relate in part to the safety of the means used to locate underground utility installations that, if damaged during an uncovering operation, could pose serious hazards to employees.

*Under these provisions, what constitutes an acceptable method of uncovering underground utility lines, and further, would the use of hydro-vacuum excavation be acceptable under the standard?*

### **Answer**

#### **Background**

Two sections of 29 CFR 1926 Subpart P (Excavations), 1926.651(Specific excavation requirements), govern methods for uncovering underground utility installations. Specifically, paragraph (b)(2) states:

When utility companies or owners cannot respond to a request to locate underground utility installations within 24 hours \* \* \* or cannot establish the exact location of these installations, the employer may proceed, provided the employer does so with caution, and provided detection equipment or other acceptable means to locate utility installations are used. (emphasis added).

Paragraph (b)(3) provides:

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#### ATTACHMENT 4 (Continued)

When excavation operations approach the estimated location of underground installations, the exact location of the installations shall be determined by safe and acceptable means. (emphasis added).

Therefore, “acceptable means” must be used where the location of the underground utilities have not been identified by the utility companies and detection equipment is not used.

Subpart P does not contain a definition of either “other acceptable means” or “safe and acceptable means.” The preambles to both the proposed rule and the final rule discussed the rationale behind the wording at issue. For example, the preamble to the proposed rule, 52 Fed. Reg. 12301 (April 15, 1987), noted that a 1972 version of this standard contained language that specified “careful probing or hand digging” as the means to uncover utilities. The preamble then noted that an amendment to the 1972 standard later deleted that language “to allow other, *equally effective means* of locating such installations.” The preamble continued that in the 1987 proposed rule, OSHA again proposed using language in section (b)(3) that would provide another example of an acceptable method of uncovering utilities that could be used where the utilities have not been marked and detection equipment is not being used – “probing with hand-held tools.” This method was rejected in the final version of 29 CFR 1926. As OSHA explained in the preamble to the final rule, 54 Fed. Reg. 45916 (October 31, 1989):

OSHA received two comments \* \* \* and input from ACCSH [OSHA’s Advisory Committee on Construction Safety and Health] \* \* \* on this provision. All commenters recommended dropping ‘such as probing with hand-held tools’ from the proposed provision, because this could create a hazard to employees by damaging the installation or its insulation.

In other words, the commenters objected to the use of hand tools being used unless detection equipment was used in conjunction with them. OSHA then concluded its discussion relative to this provision by agreeing with the commentators and ultimately not including any examples of “acceptable means” in the final provision.

#### Non-conductive hand tools are permitted

This raises the question of whether the standard permits the use of hand tools alone -- without also using detection equipment. NUCA and other industry stakeholders have recently informed us that non-conductive hand tools that are appropriate to be used to locate underground utilities are now commonly available.

Such tools, such as a “shooter” (which has a non-conductive handle and a snub nose) and non-conductive or insulated probes were not discussed in the rulemaking. Since they were not considered at that time, they were not part of the class of equipment that was thought to be unsafe for this purpose. Therefore, we conclude that the use of these types of hand tools, when used with appropriate caution, is an “acceptable means” for locating underground utilities.

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##### Hydro-vacuum excavation

It is our understanding that some hydro-vacuum excavation equipment can be adjusted to use a minimum amount of water and suction pressure. When appropriately adjusted so that the equipment will not damage underground utilities (especially utilities that are particularly vulnerable to damage, such as electrical lines), use of such equipment would be considered a “acceptable means” of locating underground utilities. However, if the equipment cannot be sufficiently adjusted, then this method would not be acceptable under the standard.

##### Other technologies

We are not suggesting that these are the only devices that would be “acceptable means” under the standard. Industry stakeholders have informed us that there are other types of special excavation equipment designed for safely locating utilities as well.

We apologize for any confusion our July 7 letter may have caused. If you have further concerns or questions, please feel free to contact us again by fax at: U.S. Department of Labor, OSHA, Directorate of Construction, Office of Construction Standards and Compliance Assistance, fax # 202-693-1689. You can also contact us by mail at the above office, Room N3468, 200 Constitution Avenue, N.W., Washington, D.C. 20210, although there will be a delay in our receiving correspondence by mail.

Sincerely,

Russell B. Swanson, Director  
Directorate of Construction

**NOTE:** OSHA requirements are set by statute, standards and regulations. Our interpretation letters explain these requirements and how they apply to particular circumstances, but they cannot create additional employer obligations. This letter constitutes OSHA's interpretation of the requirements discussed. Note that our enforcement guidance may be affected by changes to OSHA rules. Also, from time to time we update our guidance in response to new information. To keep apprised of such developments, you can consult OSHA's website at <http://www.osha.gov>.



# STANDARD OPERATING PROCEDURES

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Effective Date	01/2012	Revision	8
Applicability	Tetra Tech, Inc.		
Prepared	Earth Sciences Department		
Approved	J. Zimmerly		

Subject  
GROUNDWATER SAMPLE ACQUISITION AND  
ONSITE WATER QUALITY TESTING

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## 1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the process to be used for purging groundwater monitoring wells prior to sampling, for collecting groundwater samples, and for measuring groundwater quality parameters.

## 2.0 SCOPE

This document provides information on proper sampling equipment, onsite water quality testing, safety measures to ensure the safety of the field technician(s), and techniques for groundwater sampling. All personnel are encouraged to review the information contained herein to facilitate planning of the field sampling effort. The techniques described shall be followed whenever applicable, noting that site-specific conditions or project-specific plans may require modifications to methodology.

## 3.0 GLOSSARY

Conductivity – Conductivity is a numerical expression of the ability of an aqueous solution to carry an electric current. This ability depends on the presence of ions and their total concentration, mobility, valence, and relative concentrations and on temperature. Conductivity is highly dependent on temperature and should be reported at a particular temperature, i.e., 20.2 microSiemens per centimeter (mS/cm) at 14°C.

Dissolved Oxygen (DO) – DO levels in natural and wastewater depend on the physical, chemical, and biochemical activities in the water sample.

Groundwater Sample – A quantity of water removed from the ground, usually via a monitoring well that may or may not be lined with a well casing.

Oxidation-Reduction Potential (ORP) - A measure of the activity ratio of oxidizing and reducing species as determined by the electromotive force developed by a noble metal electrode immersed in water, as referenced against a reference electrode. A reference electrode commonly used in the field is the silver/silver chloride electrode, which has a voltage offset of about 210 mV from the standard hydrogen electrode (SHE). To convert field ORP measurements to equivalent SHE values, approximately 210 mV must be added to the ORP values obtained using the silver/silver chloride electrode. The actual offset depends on the concentration of the potassium chloride (KCl) in the field reference electrode and the temperature. Offsets typically range from 199 (saturated KCl) to 205 (3.5 Molar KCl) to 222 mV (1 Molar KCl) at 25°C and are greater at lower temperatures.

pH - The negative logarithm (base 10) of the hydrogen ion activity. The hydrogen ion activity is related to the hydrogen ion concentration, and, in a relatively weak solution, the two are nearly equal. Thus, for all practical purposes, pH is a measure of the hydrogen ion concentration.

pH Paper - Indicator paper that turns different colors depending on the pH of the solution to which it is exposed. Comparison with color standards supplied by the manufacturer will then give an indication of the solution's pH.

Representativeness – A qualitative description of the degree to which an individual sample accurately reflects population characteristics or parameter variations at a sampling point. It is therefore an important characteristic not only of assessment and quantification of environmental threats posed by the site, but also for providing information for engineering design and construction. Proper sample location selection and proper sample collection methods are important to ensure that a truly representative sample has been collected.

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Salinity – The measurement of dissolved salts in a given mass of solution. Note: most field meters determined salinity automatically from conductivity and temperature. The value will be displayed in either parts per thousand (ppt) or percent (e.g., 35 ppt equals 3.5 percent). The parts per thousand symbol ( $^0/_{00}$ ) is not the same as the percent symbol (%).

Turbidity – Turbidity in water is caused by suspended matter such as clay, silt, and fine organic and inorganic matter. Turbidity is an expression of the optical property that causes light to be scattered and absorbed rather than transmitted in a straight line through the sample.

#### 4.0 RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS

Project Manager - The Project Manager is responsible for determining the sampling objectives, initial sampling locations, and field procedures used in the collection of groundwater samples. Additionally, in consultation with other project personnel (geologist, hydrogeologist, etc.), the Project Manager identifies sampling locations.

Site Safety Officer (SSO) - The SSO (or a qualified designee) is responsible for providing the technical support necessary to implement the project Health and Safety Plan (HASP). This includes but is not be limited to performing air quality monitoring during sampling, boring and excavation activities, and ensuring that workers and offsite (downwind) individuals are not exposed to hazardous levels of airborne contaminants. The SSO or SSO designee may also be required to advise the FOL on other safety-related matters regarding sampling, such as mitigative measures to address potential hazards from hazardous objects or conditions.

Project Geologist/Sampler - The project geologist/sampler is responsible for the proper acquisition of samples in accordance with this SOP or other project-specific documents. In addition, this individual is responsible for the completion of all required paperwork (e.g., sample log sheets, field notebook, boring logs, container labels, custody seals, and chain-of-custody forms) associated with the collection of those samples.

Project Hydrogeologist – This individual is responsible for selecting and detailing the specific groundwater sampling techniques, onsite water quality testing (type, frequency, and location), equipment to be used, and providing detailed input in this regard to the project planning documents. The project hydrogeologist is also responsible for properly briefing and overseeing the performance of site sampling personnel.

Field Operations Leader (FOL) – This individual is primarily responsible for the execution of the planning document containing the Sampling and Analysis Plan (SAP). This is accomplished through management of a field sampling team for the proper acquisition of samples. He or she is responsible for the supervision of onsite analyses; ensuring proper instrument calibration, care, and maintenance; sample collection and handling; the completion and accuracy of all field documentation; and making sure that custody of all samples obtained is maintained according to proper procedures. When appropriate and as directed by the FOL, such responsibilities may be performed by other qualified personnel (e.g., field technicians) where credentials and time permit. The FOL is ultimately responsible for adherence to Occupational Safety and Health Administration (OSHA) regulations during these operations through self acquisition or through the management of a field team of samplers.

General personnel qualifications for groundwater sample collection and onsite water quality testing include the following:

- Occupational Safety and Health Administration (OSHA) 40-hour and applicable refresher training.
- Capability of performing field work under the expected physical and environmental (i.e., weather) conditions.



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- Familiarity with appropriate procedures for sample documentation, handling, packaging, and shipping.

## 5.0 HEALTH AND SAFETY

Specific safety and health precautions are identified throughout this SOP. In addition to those precautions, the following general hazards may be incurred during sampling activities:

- Knee injuries from kneeling on hard surfaces
- Slips, trips, and falls
- Cuts and lacerations
- Traffic hazards associated with sampling in parking areas and roadways and along highways.

Methods of avoiding these hazards are provided below.

**Knee injuries** – Many monitoring wells are installed as flush mounts. Personnel are required to kneel to open these wells and to take groundwater level measurements, etc. This could result in knee injuries from kneeling on stones/foreign objects and general damage due to stress on the joints. To combat this hazard:

- Clear any foreign objects from the work area.
- Wear hard-sided knee pads.

**Slips, Trips, and Falls** – These hazards exist while traversing varying terrains carrying equipment to sample wells. To minimize these hazards:

- Pre-survey well locations. Eliminate, barricade, or otherwise mark physical hazards leading to the locations.
- Carry small loads that do not restrict the field of vision.
- Travel the safest and clearest route (not necessarily the shortest).

**Cuts and Lacerations** – To prevent cuts and lacerations associated with groundwater sampling, the following provisions are required:

- Always cut away from yourself and others when cutting tubing or rope. This will prevent injury to yourself and others if the knife slips.
- Do not place items to be cut in your hand or on your knee.
- Change blades as necessary to maintain a sharp cutting edge. Many accidents result from struggling with dull cutting attachments.
- Whenever practical, wear cut-resistant gloves (e.g., leather or heavy cotton work gloves) at least on the hand not using the knife.
- Keep cutting surfaces clean and smooth.

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- Secure items to be cut -- do not hold them against the opposing hand, a leg, or other body part.
- When transporting glassware, keep it in a hard-sided container such as a cooler so that if there is a fall, you will be less likely to get cut by broken glass.
- DO NOT throw broken glass or glass ampoules into garbage bags. Place broken glass and glass ampoules in hard-sided containers such as a cardboard box or directly into a dumpster. DO NOT reach into garbage bags to retrieve any item accidentally thrown away. Empty the contents onto a flat surface to avoid punctures and lacerations from reaching where you cannot see.

**Vehicular and Foot Traffic Hazards** – When sampling along the roadway or near traffic patterns, follow the following precautions:

- Motorists may be distracted by onsite activities – ASSUME THEY DO NOT SEE YOU OR MEMBERS OF YOUR FIELD CREW.
- DO NOT place obstructions (such as vehicles) along the sides of the road that may cause site personnel to move into the flow of traffic to avoid your activities or equipment or that will create a blind spot.
- **Provide a required free space of travel.** Maintain at least 6 feet of space between you and moving traffic. Where this is not possible, use flaggers and/or signs to warn oncoming traffic of activities near or within the travel lanes.
- Face Traffic. Whenever feasible, if you must move within the 6 feet of the required free space or into traffic, attempt to face moving traffic at all times. Always leave yourself an escape route.
- Wear high-visibility vests to increase visual recognition by motorists.
- Do not rely on the vehicle operator's visibility, judgment, or ability. Make eye contact with the driver. Carefully and deliberately use hand signals so they will not startle or confuse motorists or be mistaken for a flagger's direction before moving into traffic.
- Your movements may startle a motorist and cause an accident, so move deliberately. Do not make sudden movements that might confuse a motorist.

## 6.0 PROCEDURES

### 6.1 General

For information derived from a groundwater sample to be useful and accurate, the sample must be representative of the particular zone being sampled. The physical, chemical, and bacteriological integrity of the sample must be maintained from the time of sampling to the time of analysis to keep any changes in water quality parameters to a minimum.

#### **CAUTION**

A closed well may generate and accumulate gases due to biological degradation, evolution of volatile chemicals from groundwater into the air, or other chemical actions. These gases may also be artificially generated, such as in the case of air sparging or

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extraction wells, which may take several days to depressurize. See Section 6.6.2 for safety measures to be employed to protect sampling personnel.

Methods for withdrawing samples from completed wells include the use of pumps, compressed air or nitrogen, bailers, and various types of samplers. The primary considerations in obtaining a representative sample of groundwater are to avoid collection of stagnant (standing) water in the well and to avoid physical or chemical alteration of the water sample due to external influences of the sampling technique(s). In a non-pumping well, there will be little or no vertical mixing of water in the well pipe or casing, and stratification will occur. The well water in the screened section will mix with groundwater due to normal flow patterns, but the well water above the screened section will remain isolated and become stagnant. Concentration gradients resulting from mixing and dispersion processes, layers of variable geologic permeability, and the presence of separate-phase product (e.g., floating hydrocarbons) may cause stratification. Excessive pumping or improper sampling methods can dilute or increase contaminant concentrations in the collected sample compared to what is representative of the integrated water column as it naturally occurs at that point, resulting in the collection of a non-representative sample. To safeguard against collecting non-representative samples, the following approach shall be followed prior to sample acquisition:

**CAUTION**

Mechanical agitation of well water may cause off-gas generation of volatile contaminants, creating an inhalation exposure to the sampler(s). Where avoiding an inhalation exposure is not possible and mechanical agitation is possible, pump into closed-top containers to control potential air emissions.

1. If possible, position yourself (and the sampling equipment) upwind of the well head.
2. Purge the monitoring well to be sampled prior to obtaining any samples from it. Evacuation of three to five well volumes is recommended prior to sampling, unless low-flow purging and sampling methods are utilized as described in Section 6.7 (Consult the site-specific SAP for exact purging parameters). In a high-yielding groundwater formation and where there is no stagnant water in the well above the screened section, extensive evacuation prior to sample withdrawal is not as critical as it is in a low-yielding well or in wells containing stagnant water.
3. For wells with low yields that are purged dry during sampling, evacuate the well and allow it to recover to 75 percent of full capacity prior to sample acquisition. If the recovery rate is fairly rapid (generally 300 mL per minute or greater), attempt to continue evacuation until the number of well volumes specified in the SAP is achieved. If this cannot be accomplished, allow recovery to 75 percent of capacity and begin sampling.

**CAUTION**

For moderate to high-yielding monitoring wells, an evacuation rate that does not cause excessive turbulence in the well should be selected. There is no absolute safeguard against contaminating the sample with stagnant water; hence, special techniques are required for purging to minimize the potential for sample contamination (see below).

4. For moderate to high-yielding monitoring wells, use one of the following purge techniques:
  - Place a submersible pump or the intake line of a surface pump or bailer just below the water surface when removing the stagnant water.

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- While purging and as the water level decreases, lower the pump or intake line as the water level drops in the well. Three to five volumes of water shall be removed to provide reasonable assurance that all stagnant water has been evacuated. After this is accomplished, a bailer or other approved device may be used to collect the sample for analysis.
- Unless otherwise directed, place the intake line of the sampling pump (or the submersible pump itself) near the center of the screened section, and pump approximately one casing volume of water from the well at a low purge rate equal to the well's recovery rate (low-flow sampling).

## 6.2 **Sampling, Monitoring, and Evacuation Equipment**

Sample containers shall conform to the guidelines in SOP SA-6.1.

The following equipment shall be on hand when sampling groundwater wells (reference SOPs SA-6.1 and SA-7.1):

- Sample packaging and shipping equipment – Coolers for sample shipping and cooling, chemical preservatives, appropriate sampling containers and filler materials, ice, labels, and chain-of-custody documents.
- Field tools and instrumentation
  - Multi-parameter water quality meter with an in-line sample chamber capable of measuring ORP, pH, temperature, DO, specific conductance, turbidity, and salinity, or individual meters (as applicable)
  - pH Paper
  - Camera and film (if appropriate)
  - Appropriate keys (for locked wells)
  - Water level indicator and/or oil-water interface probe if separate-phase product is expected
- Pumps
  - Shallow-well pumps: Centrifugal, bladder, suction, or peristaltic pumps with drop lines and air-lift apparatus (compressor and tubing) where applicable.
  - Deep-well pumps: Submersible pump and electrical power-generating unit, or bladder pumps where applicable.
- Other sampling equipment – Bailers, graduated cylinder, stopwatch, and inert line with tripod-pulley assembly (if necessary).
- Pails – Plastic, graduated.
- Clean paper or cotton towels for cleaning equipment.
- Buckets with lids for collecting purge water.

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- Decontamination solutions – Deionized water, potable water, phosphate-free laboratory-grade detergent, and analytical-grade solvent (e.g., pesticide-grade isopropanol), as required.

Ideally, sample withdrawal equipment shall be completely inert, economical, easily cleaned, cleaned prior to use, reusable, able to operate at remote sites in the absence of power sources, and capable of delivering variable rates for well purging and sample collection.

### 6.3 Calculations of Well Volume

To ensure that the proper volume of water has been removed from the well prior to sampling, it is first necessary to know the volume of standing water in the well pipe (including well screen where applicable). This volume can be easily calculated by the following method. Calculations shall be entered in the site logbook or field notebook or on a sample log sheet form or equivalent electronic form(s) (see SOP SA-6.3):

1. Obtain all available information on well construction (location, casing, screen, etc.).
2. Determine well or inner casing diameter.
3. Measure and record static water level (depth below ground level or top of casing reference point).
4. Determine depth of well by sounding using a clean, decontaminated, weighted tape measure or water level indicator.
5. Calculate number of linear feet of static water (total depth or length of well pipe minus the depth to static water level).
6. Calculate one static well volume in gallons  $V = (0.163)(T)(r^2)$

where: V = Static volume of well in gallons.  
T = Linear feet of water in the well.  
r = Inside radius of well casing in inches.  
0.163 = Conversion factor (compensates for conversion of casing radius from inches to feet and cubic feet to gallons and pi.

7. Per evacuation volumes discussed above, determine the minimum amount to be evacuated before sampling.

Measuring devices may become contaminated when gathering the above information if they are submerged in contaminated water. Decontamination of the tape or water level indicator must be conducted between measurements in different wells as follows:

1. Saturate a paper towel or clean cotton towel with deionized water.
2. As the measuring device is extracted, wipe the tape, changing the cleaning surface frequently.
3. After it is extracted, rinse the probe or tape using a spray bottle of deionized water over a bucket or similar collection container.

Based on the contaminant (oily, etc), it may be necessary to use a soap and water wash and rinse to remove contaminants. Isopropanol can be used on the probe/tape. However, it is recommended that the use of solvents on the tape be minimized because they could degrade the protective covering or possibly

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remove the scale designations. If isopropanol (or some other solvent) is used, assure that the manufacturer/supplier Material Safety Data Sheet (MSDS) is obtained, kept on site at a readily available location with other MSDSs, and reviewed by personnel prior to the first usage of the solvent. Also, add the substance to the site-specific Hazardous Chemical Inventory list (see Section 5 of the TtNUS Health and Safety Guidance Manual [HSGM], Hazard Communication Program and OSHA Standard 29 CFR 1910.1200).

#### **6.4 Evacuation of Static Water – Purging**

##### **6.4.1 General**

The amount to be purged from each well will be determined prior to sample collection. This amount will depend on the intent of the monitoring program and the hydrogeologic conditions. Programs to determine overall quality of water resources may require long pumping periods to obtain a sample that is representative of a large volume of the aquifer. The pumped volume may be specified prior to sampling so that the sample can be a composite of a known volume of the aquifer. Alternately, the well can be pumped until parameters such as temperature, specific conductance, pH, and turbidity (as applicable) have stabilized. Onsite measurements of these parameters shall be recorded in the site logbook or field notebook or on standardized data sheets or an equivalent electronic form(s).

##### **6.4.2 Evacuation Devices**

The following discussion is limited to those devices commonly used at hazardous waste sites. Attachment A provides guidance on the proper evacuation device to use for given sampling situations. All of these techniques involve equipment that is portable and readily available.

##### **Bailers**

Bailers are the simplest evacuation devices used and have many advantages. They generally consist of a length of tubing equipped with a base plate and ball check-valve at the bottom. Bailers are comprised of stainless steel and plastic. They come in a variety of sizes, but the two most often used are 2 inches and 4 inches in diameter. An inert non-absorbent line such as polyethylene rope is used to lower and then raise the bailer to retrieve the sample. As the bailer is lowered into the water column, the ball is pushed up allowing the tube to be filled. When the bailer is pulled upward, the ball seats in the base plate preventing water from escaping.

Advantages of bailers include the following:

- There are few limitations on size and materials used.
- No external power source is needed.
- Bailers are inexpensive and can be dedicated and hung in a well to reduce the chances of cross-contamination.
- Bailers are relatively easy to decontaminate.

Limitations on the use of bailers include the following:

- It is time consuming to remove stagnant water using a bailer.

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- Splashing the bailer into the water or transfer of sample may cause aeration.
- The use of a bailer does not permit constant in-line monitoring of groundwater parameters.
- Use of bailers is physically demanding, especially in warm temperatures at personal protection equipment (PPE) levels above Level D.

Safety concerns using a bailer include the following:

- Muscle stress and strain, especially when using 4-inch bailers and when pulling from excessively deep wells.
- Entanglement, possible hand/finger injuries, and rope burns during a sudden release of the bailer back down the well.
- Direct contact with contaminants of concern and sample preservatives when discharging the bailer contents because there is not a high level of control during a direct pour, and splashing and indirect contact with contaminants/preservatives could occur.

Control measures for these hazards are provided in Section 6.6.2.

#### Suction Pumps

There are many different types of inexpensive suction pumps including centrifugal, diaphragm, and peristaltic pumps. Centrifugal and diaphragm pumps can be used for well evacuation at a fast pumping rate and for sampling at a low pumping rate. The peristaltic pump is a low-volume pump that uses rollers to squeeze flexible tubing to create suction. This tubing can be dedicated to a well to prevent cross-contamination from well to well. Suction pumps are all portable, inexpensive, and readily available. However, because they are based on suction, their use is restricted to areas with water levels within 20 to 25 feet of the ground surface. A significant limitation is that the vacuum created by these pumps can cause loss of dissolved gases and volatile organics. Another limitation of these pumps is that they require a secondary energy source to drive them. Electrically driven pumps may require portable generators as energy sources. Air diaphragm pumps require air compressors and/or compressed gas cylinders to drive them. The advantage of the peristaltic pump is that it will operate from a portable battery source. Safety measures associated with these pumps are provided below.

#### Air-Lift and Gas-Lift Samplers

This group of pump samplers uses gas pressure either in the annulus of the well or in a venturi to force groundwater up a sampling tube. These pumps are also relatively inexpensive. Air- or gas-lift samplers are more suitable for well development than for sampling because the samples may be aerated as a result of pump action. Aeration can cause pH changes and subsequent trace metal precipitation or loss of volatile organics.

#### Submersible Pumps

Submersible pumps take in water and push the sample up a sample tube to the surface. The power sources for these samplers may be compressed gas or electricity. Operation principles vary, and displacement of the sample can be by an inflatable bladder, sliding piston, gas bubble, or impeller. Pumps are available for 2-inch-diameter wells and larger. These pumps can lift water from considerable depths (several hundred feet).

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Limitations of this class of pumps include the following:

- They may have low delivery rates.
- Many models are expensive.
- Compressed gas or electric power is needed.
- Sediment in water may cause clogging of the valves or eroding of the impellers with some of these pumps.
- Decontamination of internal components can be difficult and time consuming.

#### Compressed Gases

Safety concerns using compressed gases as an energy source in these pumps are numerous. The nitrogen gas or compressed air is provided in a compressed gas cylinder at a pressure of approximately 2,000 psi. If damaged, these cylinders can become dangerous projectiles. Additionally, a sudden release of a cylinder's contents can involve considerable force that could cause significant damage to the eyes and/or skin. Protective measures include the following:

- Always wear safety impact glasses when handling compressed gases.
- Always administer compressed gases through an appropriate pressure-reducing regulator.
- When clearing the cylinder connection port, open the cylinder valve only enough to clear foreign debris. During this process, always position the cylinder valve so that it faces away from you and others.
- If the cylinder is designed to accept a valve protection cap, always keep that protection cap in place, except the cylinder is connected for use.
- When using the cylinder, lay the cylinder on its side to avoid the potential of it falling and knocking the valve off (and becoming a missile).
- DO NOT use the compressed nitrogen or air to clean clothing or to spray off the skin. Small cuts in the protective layer of the skin may permit the gas to enter into the bloodstream, presenting the potential danger of an embolism.

See the project-specific HASP for additional direction concerning cylinder safe handling procedures pertaining to the safe handling, transportation, and storage of compressed gas cylinders.

#### Electrical Shock

Even in situations where portable batteries are used, the potential for electrical shock exists. This potential risk is increased in groundwater sampling activities because of the presence of groundwater near the batteries. This potential is also increased in (prohibited) situations where jury-rigging of electrical connections is performed. Other potential hazards occur when field samplers open the hood of a running car to access the battery as a power source. To control these hazards:



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- If you are unfamiliar with electrical devices, do not experiment, get help, and get the proper equipment necessary to power your device.
- Use the proper portable power inverters for cigarette lighter connections to minimize the need to access the battery under the hood of your vehicle.
- Use of electrical generators may pose a number of hazards including noise, those associated with fueling, and indirect sample influence.

To minimize or eliminate electrical generator hazards:

- Inspect the generator before use. Ensure that the generator and any extension cords are rated for the intended operation and have a Ground Fault Circuit Interrupter (GFCI) in line to control potential electrical shock.
- Fuel the generator before purging and sampling to avoid loss of power during sampling.
- Fuel engines only when they are turned OFF and have cooled sufficiently to prevent a fire hazard.
- Place the generator and any fuel source at least 50 feet from the well to be sampled to avoid indirect influence to the sample from fuel vapors or emission gases.

#### Lifting Hazards

This hazard may be experienced when moving containers of purge water, equipment, cylinders, etc. To control these potential hazards:

- Do not fill purge buckets to more than 80 percent of their capacity.
- Obtain a gas cylinder of sufficient size to complete the designated task but not too large to handle. K-size cylinders weigh approximately 135 pounds and are difficult to handle. M-size cylinders weigh approximately 50 pounds and are easier to handle and move.
- When necessary, get help lifting and moving gas cylinders and other heavy objects. Minimize twisting and turning while lifting. If it is necessary to move these cylinders or generators over significant distance, use mechanical means (carts, etc.).
- Use proper lifting techniques as described in Section 4.4 of the HSGM.

### 6.5 Onsite Water Quality Testing

This section describes the procedures and equipment required to measure the following parameters of an aqueous sample in the field:

- pH
- Specific conductance
- Temperature
- DO
- ORP
- Turbidity
- Salinity

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This section is applicable for use in an onsite groundwater quality monitoring program to be conducted at a hazardous or nonhazardous waste site. The procedures and equipment described are applicable to groundwater samples and are not, in general, subject to solution interferences from color, turbidity, or colloidal material or other suspended matter.

This section provides general information for measuring the parameters listed above with instruments and techniques in common use. Because instruments from different manufacturers may vary, review of the manufacturer's literature pertaining to the use of a specific instrument is required before use. Most meters used to measure field parameters require calibration on a daily basis. Refer to SOP SA-6.3 for an example equipment calibration log.

### **6.5.1 Measurement of pH**

#### **6.5.1.1 General**

Measurement of pH is one of the most important and frequently used tests in water chemistry. Practically every phase of water supply and wastewater treatment such as acid-base neutralization, water softening, and corrosion control is pH dependent. Likewise, the pH of leachate can be correlated with other chemical analyses to determine the probable source of contamination. It is therefore important that reasonably accurate pH measurements be taken and recorded on the groundwater sample log sheet (Attachment B) or equivalent electronic form.

Two methods are given for pH measurement: the pH meter and pH indicator paper. Indicator paper is used when only an approximation of the pH is required or when pH meter readings need to be verified, and the pH meter is used when a more accurate measurement is needed. The response of a pH meter can be affected by high levels of colloidal or suspended solids, but the effect is generally of little significance. Consequently, specific methods to overcome this interference are not described. The response of pH paper is unaffected by solution interferences from color, turbidity, or colloidal or suspended materials unless extremely high levels capable of coating or masking the paper are encountered. In such cases, use of a pH meter is recommended.

#### **6.5.1.2 Principles of Equipment Operation**

Use of pH papers for pH measurement relies on a chemical reaction caused by the acidity or alkalinity of the solution created by the addition of the water sample reacting with the indicator compound on the paper. Various types of pH papers are available, including litmus (for general acidity or alkalinity determination) and specific, or narrower range, pH range paper.

Use of a pH meter relies on the same principle as other ion-specific electrodes. Measurement relies on establishment of a potential difference across a glass or other type of membrane in response to (in this instance, hydrogen) ion activity (which is usually similar to concentration) across that membrane. The membrane is conductive to ionic species and, in combination with a standard or reference electrode, a potential difference proportional to the ion concentration is generated and measured.

#### **6.5.1.3 Equipment**

The following equipment is to be used for obtaining pH measurements:

- A stand-alone portable pH meter or combination meter equipped with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22).

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- Combination electrode with polymer body to fit the above meter. Alternately, a pH electrode and a reference electrode can be used if the pH meter is equipped with suitable electrode inputs.
- Buffer solutions, as specified by the manufacturer. If the buffer solutions are considered hazardous per 29 Code of Federal Regulations (CFR) 1910.1200 (Hazard Communication) or the volumes used are greater than consumer commodity levels, the SSO shall obtain MSDSs from the manufacturer for the specific buffer solutions (see Section 4 of the HSGM regarding the Hazard Communication Program)
- pH indicator paper to cover the pH range 2 through 12.
- Manufacturer's operation manual. All personnel must be familiar with the equipment operation to ensure that the integrity of samples is preserved and that the equipment is operated safely.

#### 6.5.1.4 Measurement Techniques for Field Determination of pH

##### pH Meter

The following procedure shall be used for measuring pH with a pH meter (meter standardization is according to manufacturer's instructions):

1. Inspect the instrument and batteries prior to initiation of the field effort.
2. Check the integrity of the buffer solutions used for field calibration. Buffer solutions need to be changed often as a result of degradation upon exposure to the atmosphere.
3. If applicable, make sure all electrolyte solutions within the electrode(s) are at their proper levels and that no air bubbles are present within the electrode(s).
4. Calibrate the meter and electrode(s) on a daily use basis (or as recommended by manufacturer) following manufacturer's instructions. Record calibration data on a water quality meter calibration log sheet (Attachment C) or equivalent electronic form.
5. Immerse the electrode(s) in the sample. Stabilization may take several seconds to minutes. If the pH continues to drift, the sample temperature may not be stable, a physical reaction (e.g., degassing) may be taking place in the sample, or the meter or electrode may be malfunctioning. The failure of the measurements to stabilize must be clearly noted in the logbook or equivalent electronic form.
6. Read and record the pH of the sample. pH shall be recorded to the nearest 0.01 pH standard unit. Also record the sample temperature (unless otherwise specified in the SAP, record temperatures to the nearest whole degree Fahrenheit or 0.5 degree Celsius).
7. Rinse the electrode(s) with deionized water.
8. Store the electrode(s) in an accordance with manufacturer's instructions when not in use.

Any visual observation of conditions that may interfere with pH measurement, such as oily materials or turbidity, shall be noted and avoided as much as possible.

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## pH Paper

Use of pH paper is very simple and requires no sample preparation, standardization, etc. pH paper is available in several ranges, including wide-range (indicating approximately pH 1 to 12), mid-range (approximately pH 0 to 6, 6 to 9, 8 to 14) and narrow-range (many available, with ranges as narrow as 1.5 pH units). The appropriate range of pH paper shall be selected. If the pH is unknown the investigation shall start with wide-range paper and proceed with successively narrower range paper until the sample pH is determined. To measure the pH with pH paper:

1. Collect a small portion of sample into a clean container.
2. Dip the pH paper into this small portion of sample.
3. Compare the color of the paper to the color chart that is provided with the pH paper and read the corresponding pH from the chart.
4. Record the pH value from the chart on the sampling log sheet.
5. Discard the used pH paper as trash.
6. Discard the small volume of sample that was used for the pH measurement with the other investigative derived waste.

## 6.5.2 Measurement of Specific Conductance

### 6.5.2.1 General

Conductance provides a measure of dissolved ionic species in water and can be used to identify the direction and extent of migration of contaminants in groundwater or surface water. It can also be used as a measure of subsurface biodegradation or to indicate alternate sources of groundwater contamination.

Conductivity is a numerical expression of the ability of a water sample to carry an electric current. This value depends on the total concentration of ionized substances dissolved in the water and the temperature at which the measurement is made. The mobility of each of the various dissolved ions, their valences, and their actual and relative concentrations affect conductivity.

It is important to obtain a specific conductance measurement soon after taking a sample because temperature changes, precipitation reactions, and absorption of carbon dioxide from the air all affect specific conductance. Most conductivity meters in use today display specific conductance in units of mS/cm, which is the conductivity normalized to a temperature of 25°C. These are the required units to be recorded on the groundwater sample log field form or equivalent electronic form.

### 6.5.2.2 Principles of Equipment Operation

An aqueous system containing ions will conduct an electric current. In a direct-current field, the positive ions migrate toward the negative electrode, and the negatively charged ions migrate toward the positive electrode. Most inorganic acids, bases, and salts such as hydrochloric acid, sodium carbonate, and sodium chloride, respectively, are relatively good conductors. Conversely, organic compounds such as sucrose or benzene, which do not dissociate in aqueous solution, conduct a current very poorly if at all.

A conductance cell and a Wheatstone Bridge (for the measurement of potential difference) may be used for measurement of electrical resistance. The ratio of current applied to voltage across the cell may also

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be used as a measure of conductance. The core element of the apparatus is the conductivity cell containing the solution of interest. Depending on the ionic strength of the aqueous solution to be tested, a potential difference is developed across the cell, which can be converted directly or indirectly (depending on instrument type) to a measurement of specific conductance.

#### 6.5.2.3 Equipment

The following equipment is needed for taking specific conductance measurements:

- Stand-alone portable conductivity meter or combination meter equipped with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22).
- Calibration solution, as specified by the manufacturer.
- Manufacturer's operation manual.

A variety of conductivity meters are available that may also be used to monitor salinity and temperature. Probe types and cable lengths vary, so equipment must be obtained to meet the specific requirements of the sampling program.

#### 6.5.2.4 Measurement Techniques for Specific Conductance

The steps involved in taking specific conductance measurements are as follows (calibration shall be conducted according to manufacturer's instructions):

1. Check batteries and calibrate instrument before going into the field.
2. Calibrate on a daily use basis (or as recommended by manufacturer), according to the manufacturer's instructions and record all pertinent information on a water quality meter calibration log sheet or equivalent electronic form. Potassium chloride solutions with a specific conductance closest to the values expected in the field shall be used for calibration.
3. Rinse the cell with one or more portions of the sample to be tested or with deionized water and shake excess water from the cell.
4. Immerse the electrode in the sample and measure the conductivity.
5. Read and record the results in a field logbook or on a sample log sheet or equivalent electronic form.
6. Rinse the electrode with deionized water.

If the specific conductance measurements become erratic, recalibrate the instrument and see the manufacturer's instructions for troubleshooting assistance.

### 6.5.3 Measurement of Temperature

#### 6.5.3.1 General

In combination with other parameters, temperature can be a useful indicator of the likelihood of biological action in a water sample. It can also be used to trace the flow direction of contaminated groundwater. Temperature measurements shall be taken in situ, or as quickly as possible in the field because collected water samples may rapidly equilibrate with the temperature of their surroundings.

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#### 6.5.3.2 Equipment

Temperature measurements may be taken with alcohol-toluene, mercury-filled, dial-type thermometers or combination meters equipped with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22). In addition, various meters such as specific conductance or DO meters that have temperature measurement capabilities may also be used. Using such instrumentation along with suitable probes and cables, in-situ measurements of temperature at great depths can be performed.

#### 6.5.3.3 Measurement Techniques for Water Temperature

If a thermometer is used to determine the temperature for a water sample, use the following procedure:

1. Immerse the thermometer in the sample until temperature equilibrium is obtained (1 to 3 minutes). To avoid the possibility of cross-contamination, the thermometer shall not be inserted into samples that will undergo subsequent chemical analysis.
2. Record values in a field logbook or on a sample log sheet or equivalent electronic form.

If a temperature meter or probe is used:

1. Calibrate the instrument according to manufacturer's recommendations prior to use.
2. Immerse the meter/probe in the sample until temperature equilibrium is obtained (1 to 3 minutes). To avoid the possibility of cross-contamination, the meter/probe shall not be inserted into samples that will undergo subsequent chemical analysis.
3. Record values in a field logbook or on a sample log sheet or equivalent electronic form.

### 6.5.4 Measurement of Dissolved Oxygen

#### 6.5.4.1 General

DO levels in natural water and wastewater depend on the physical, chemical and biochemical activities in the water body. In addition, the growth of many aquatic organisms and the rate of corrosivity are dependent on DO concentrations. Thus, analysis for DO is a key test in water pollution and waste treatment process control. If at all possible, DO measurements shall be taken in situ because concentrations may show a large change in a short time if the sample is not adequately preserved.

The monitoring method discussed herein is limited to the use of DO meters. Chemical methods of analysis (i.e., Winkler methods) are available but require more equipment and greater sample manipulation. Furthermore, DO meters using a membrane electrode are suitable for highly polluted waters because the probe is completely submersible and is not susceptible to interference caused by color, turbidity, or colloidal material or suspended matter.

#### 6.5.4.2 Principles of Equipment Operation

DO probes are normally electrochemical cells that have two solid metal electrodes of different nobility immersed in an electrolyte. The electrolyte is retained by an oxygen-permeable membrane. The metal of highest nobility (the cathode) is positioned at the membrane. When a suitable potential exists between the two metals, reduction of oxygen to hydroxide ion (OH<sup>-</sup>) occurs at the cathode surface. An electrical

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current is developed that is directly proportional to the rate of arrival of oxygen molecules at the cathode. This rate is proportional to the oxygen concentration in the water being measured.

Because the current produced in the probe is directly proportional to the rate of arrival of oxygen at the cathode, it is important that a fresh supply of sample always be in contact with the membrane. Otherwise, the oxygen in the aqueous layer along the membrane is quickly depleted and false low readings are obtained. It is therefore necessary to stir the sample (or the probe) constantly to maintain fresh solution near the membrane interface. Stirring, however, shall not be so vigorous that additional oxygen is introduced through the air-water interface at the sample surface. To avoid this possibility, some probes are equipped with stirrers to agitate the solution near the probe, leaving the surface of the solution undisturbed.

DO probes are relatively unaffected by interferences. Interferences that can occur are reactions with oxidizing gases such as chlorine or with gases such as hydrogen sulfide that are not easily depolarized from the indicating electrode. If a gaseous interference is suspected, it shall be noted in the field logbook and checked if possible. Temperature variations can also cause interference because probes exhibit temperature sensitivity. Automatic temperature compensation is normally provided by the manufacturer. This compensation can counteract some of the temperature effects but not all of them.

#### 6.5.4.3 Equipment

The following equipment is needed to measure DO concentrations:

- A stand-alone portable DO meter or combination meter equipped with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22).
- Sufficient cable to allow the probe to contact the sample.
- Manufacturer's operation manual.

#### 6.5.4.4 Measurement Techniques for Dissolved Oxygen Determination

DO probes differ as to instructions for use. Follow the manufacturer's instructions to obtain an accurate reading. The following general steps shall be used to measure DO concentrations:

1. Check the DO meter batteries before going to the field.
2. Condition the probe in a water sample for as long a period as practical before use in the field. Long periods of dry storage followed by short periods of use in the field may result in inaccurate readings.
3. Calibrate the instrument in the field according to manufacturer's recommendations or in a freshly air-saturated water sample of known temperature.
4. Record all pertinent information on a water quality meter calibration log sheet or equivalent electronic form.
5. Rinse the probe with deionized water.
6. Immerse the probe in the sample. Be sure to provide for sufficient flow past the membrane by stirring the sample. Probes without stirrers placed in wells may be moved up and down to achieve the required mixing.

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7. Record the DO content and temperature of the sample in a field logbook or on a sample log sheet or equivalent electronic form.
8. Rinse the probe with deionized water.
9. Recalibrate the probe when the membrane is replaced, or as needed. Follow the manufacturer's instructions.

Note that in-situ placement of the probe is preferable because sample handling is not involved. This however may not always be practical.

Special care shall be taken during sample collection to avoid turbulence that can lead to increased oxygen solubilization and positive test interferences.

### **6.5.5 Measurement of Oxidation-Reduction Potential**

#### **6.5.5.1 General**

ORP provides a measure of the tendency of organic or inorganic chemicals to exist in an oxidized state. The ORP parameter therefore provides evidence of the likelihood of anaerobic degradation of biodegradable organics or the ratio of activities of reduced to oxidized species in the sample.

#### **6.5.5.2 Principles of Equipment Operation**

When an inert metal electrode, such as platinum, is immersed in a solution, a potential is developed at that electrode depending on the ions present in the solution. If a reference electrode is placed in the same solution, an ORP electrode pair is established. This electrode pair allows the potential difference between the two electrodes to be measured and is dependent on the concentration of the ions in solution. By this measurement, the ability to oxidize or reduce species in solution may be determined. Supplemental measurements, such as DO, may be correlated with ORP to provide knowledge of the quality of the solution, water, or wastewater.

#### **6.5.5.3 Equipment**

The following equipment is needed for measuring the ORP of a solution:

- A combination meter with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22).
- Reference solution as specified by the manufacturer.
- Manufacturer's operation manual.

#### **6.5.5.4 Measurement Techniques for Oxidation-Reduction Potential**

The following procedure is used for measuring ORP:

1. Check the equipment using the manufacturer's recommended reference solution and check its batteries before going to the field.
2. Thoroughly rinse the electrode with deionized water.



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3. If the probe does not respond properly to the recommended reference solution, verify the sensitivity of the electrodes by noting the change in millivolts when the pH of a test solution is altered. The ORP will increase when the pH of a test solution decreases, and the ORP will decrease when the test solution pH is increased. Place the sample in a clean container and agitate the sample. Insert the electrodes and note that the ORP drops sharply when the caustic is added (i.e., pH increases) thus indicating that the electrodes are sensitive and operating properly. If the ORP increases sharply when the caustic is added, the polarity is reversed and must be corrected in accordance with the manufacturer's instructions or the probe should be replaced.
4. Record all pertinent information on a water quality meter calibration log sheet or equivalent electronic form.

### **6.5.6 Measurement of Salinity**

#### **6.5.6.1 General**

Salinity is a unitless property of industrial and natural waters. It is the measurement of dissolved salts in a given mass of solution. Most field meters determine salinity automatically from conductivity and temperature. The displayed value will be displayed in either parts per thousand (ppt) or percent (e.g., 35 ppt equals 3.5 percent).

#### **6.5.6.2 Principles of Equipment Operation**

Salinity is determined automatically from the meter's conductivity and temperature readings according to algorithms (such as are found in Standard Methods for the Examination of Water and Wastewater). Depending on the meter, the results are displayed in either ppt or percent. The salinity measurements are carried out in reference to the conductivity of standard seawater (corrected to salinity = 35 ppt).

#### **6.5.6.3 Equipment**

The following equipment is needed for salinity measurements:

- A multi-parameter water quality meter capable of measuring conductivity and temperature and converting them to salinity (e.g., Horiba U-22 or YSI 600 series).
- Calibration solution as specified by the manufacturer.
- Manufacturer's operation manual.

#### **6.5.6.4 Measurement Techniques for Salinity**

The steps involved in taking salinity measurements are as follows (standardization shall be conducted according to manufacturer's instructions):

1. Check the expiration date of the solutions used for field calibration and replace them if they are expired.
2. Check batteries and calibrate the meter before going into the field.

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3. Calibrate on a daily use basis, according to the manufacturer's instructions and record all pertinent information on a water quality meter calibration log sheet or equivalent electronic form.
4. Rinse the cell with the sample to be tested. This is typically accomplished as the probe is placed in line during the collection of the purge water up to the time of sample acquisition.
5. Immerse the multi-probe in the sample and measure the salinity. Read and record the results in a field logbook or on a sample log sheet or equivalent electronic form.
6. Rinse the probes with deionized water.

### **6.5.7 Measurement of Turbidity**

#### **6.5.7.1 General**

Turbidity is an expression of the optical property that causes light to be scattered and absorbed rather than transmitted in a straight line through the sample. Turbidity in water is caused by suspended matter such as clay, silt, or other finely divided organic and inorganic matter and microscopic organisms including plankton.

It is important to obtain a turbidity reading immediately after taking a sample because irreversible changes in turbidity may occur if the sample is stored too long.

#### **6.5.7.2 Principles of Equipment Operation**

Turbidity is measured by the Nephelometric Method, which is based on a comparison of the intensity of light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions. The higher the scattered light intensity, the higher the turbidity.

Formazin polymer is used as the reference turbidity standard suspension because of its ease of preparation combined with a higher reproducibility of its light-scattering properties than clay or turbid natural water. The turbidity of a specified concentration of formazin suspension is defined as 40 nephelometric units. This same suspension has an approximate turbidity of 40 Jackson units when measured on the candle turbidimeter. Therefore, nephelometric turbidity units (NTUs) based on the formazin preparation will approximate units derived from the candle turbidimeter but will not be identical to them.

#### **6.5.7.3 Equipment**

The following equipment is needed for turbidity measurements:

- A turbidity meter (e.g., LaMotte 2020) that calibrates easily using test cells with standards of 0.0, 1.0, and 10 NTUs, or a combination meter equipped with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22).
- Calibration solution and sample tubes, as specified by the manufacturer.
- Manufacturer's operation manual.

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#### 6.5.7.4 Measurement Techniques for Turbidity

The steps involved in taking turbidity measurements utilizing an electrode (e) or light meter (l) are listed below (standardization shall be done according to manufacturer's instructions):

1. Check the expiration date of the solutions used for field calibration and replace them if they are expired.
2. Check batteries and calibrate the instrument before going into the field.
3. Calibrate on a daily basis according to the manufacturer's instructions, and record all pertinent information on a turbidity meter calibration log sheet (Attachment C) or equivalent electronic form.
4. When using the YSI and/or Horiba U-22, rinse the electrode with one or more portions of the sample to be tested or with deionized water.
5. When using the Lamotte 2020, fill the light meter's glass test cell with approximately 5 mL of sample, screw on the cap, wipe off glass to remove all residue that could intercept the instrument's light beam, place the test cell in the light meter, and close the lid.
6. Immerse the electrode in the sample and measure the turbidity.
7. The reading must be taken immediately because suspended solids will settle over time resulting in a lower, inaccurate turbidity reading.
8. Read and record the results in a field logbook or on a sample log sheet or equivalent electronic form. Include a physical description of the sample, including color, qualitative estimate of turbidity, etc.
9. Rinse the electrode or test cell with deionized water.

### 6.6 Sampling

#### 6.6.1 Sampling Plan

The sampling approach consisting of the following shall be developed as part of the project planning documents approved prior to beginning work in the field:

- Background and objectives of sampling.
- Brief description of area and waste characterization.
- Identification of sampling locations, with map or sketch, and applicable well construction data (well size, depth, screened interval, reference elevation).
- Intended number, sequence, volumes, and types of samples. If the relative degree of contamination between wells is insignificant, a sampling sequence that facilitates sampling logistics may be followed. Where some wells are known or strongly suspected of being highly contaminated, these shall be sampled last to reduce the risk of cross-contamination between wells. In situations where the well is not well-characterized and the nature or extent of airborne contamination is unknown, it is recommended that head space analysis using a photoionization detector (PID) or flame ionization detector (FID) is performed to rate the wells, sampling from least contaminated to most contaminated.

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Refer to the project-specific HASP for appropriate information and direction on air monitoring requirements.

- Sample preservation requirements.
- Work schedule.
- List of team members.
- List of observers and contacts.
- Other information, such as the necessity for a warrant or permission of entry, requirements for split samples, access problems, location of keys, etc.
- The FOL shall ensure that the sampling method(s) to be employed is accurately represented in the HASP, indicating the types of sampling to be employed and the hazards. If the methods are not accurately represented, the FOL should rectify this with the HASP author.
- The FOL shall ensure that sampling teams understand the sampling approach that they are to follow. Where sampling teams are made up of personnel from multiple locations, personal sampling experiences may vary. Therefore the FOL shall review project-specific requirements, SOPs, and protocol to be followed. The FOL will conduct periodic surveys to ensure that these methods are being completed per his/her direction.

#### **6.6.2 Sampling Methods as Related to Low-Flow Sampling**

The collection of a groundwater sample consists of the following steps:

1. Ensure the safety of the sample location. Take a few minutes to evaluate the area for physical hazards (trip hazards, uneven ground, overhanging branches, etc.) and natural hazards (snakes, bees, spiders, etc.) that may exist in the area or that may have constructed nests in the well head. Snakes often like to sun themselves on concrete well pads. Follow provisions in the project-specific HASP and/or HSGM for addressing natural hazards.
2. As indicated earlier, some monitoring wells have the potential to contain pressurized headspace (e.g., through the generation of gases from contaminated groundwater, due to biological processes, degradation of contaminants, or simply based on location such as near a landfill or in areas that intersect lithological abnormalities) or through intentional artificial means such as those associated with air sparging systems. Injection or extraction wells may be artificially pressurized and may remain so for several days after the system has been turned off. This presents a hazard to people opening these wells. The Field Sampling Technician shall employ the following practices to minimize these hazards:
  - Wear safety glasses to protect the eyes. If site-specific observations and conditions indicate that the wells may be pressurized, wear a full-face shield over the safety impact eye protection.
  - DO NOT place your face or any other part of your body over the well when opening because this may place you in a strike zone.
  - Open the well cover at arms length, then step away and allow the well to off gas and stabilize.

Follow directions provided in the project-specific HASP, Work Plan and/or Sampling Plan pertaining to the use of volatile chemical detection equipment (PID or FID) within the breathing zone of the

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sampler during sampling to determine the need to retreat from the work area and/or for the use of respiratory protection (as specified in the HASP).

3. When proper respiratory protection has been donned, sound the well for total depth and water level (using clean equipment) and record these data on a groundwater sampling log sheet or equivalent electronic form; then calculate the fluid volume in the well pipe (as previously described in this SOP). It is imperative that downhole equipment be adequately decontaminated between wells to prevent cross-contamination. Just as sampling occurs from the least contaminated to the most contaminated, it is also recommended that groundwater level measurements be taken in this manner.
4. Calculate volume of well water to be removed as described in Section 6.3.
5. Select the appropriate purging equipment (see Attachment A to this SOP) or as designated within your Work Plan/Sampling Plan. If an electric submersible pump with packer is chosen, go to Step 10.
6. Lower the purging equipment or intake into the well to a short distance below the water level or mid-screen as indicated in project-specific documentation and begin water removal. Remember that some contaminants are "bottom dwellers," and in these cases, project-specific direction may specify placing the intake just above (1 to 2 feet) the well bottom. Secure the pump intake at the well and secure the effluent at the collection container and begin pumping. The pumping rate will be determined based on the decrease in the water level (see Section 6.7) or as directed in your project-specific documents or this SOP. Purge water is generally collected in a 5-gallon bucket or similar open- or closed-top container. To minimize the potential for spills and back injuries, do not fill 5-gallon buckets beyond approximately 80 percent of their capacity. Dispose of purge water as indicated in the planning document(s). Where necessary, slow the pumping rate or lower the pump intake as required to maintain submergence.
7. Estimate the approximate rate of discharge frequently and record it on the Low Flow Purge Data Sheet (see Attachment D). Estimate flow rate by noting the amount of discharge in a bucket or graduated cylinder per unit time using a watch with a second hand or a stopwatch.
8. Observe the peristaltic pump tubing intake for degassing "bubbles." If bubbles are abundant and the intake is fully submerged, this pump is not suitable for collecting samples for volatile organics.
9. Purge a minimum of three to five casing volumes before sampling (or as directed by the site-specific SAP). In low-permeability strata (i.e., if the well is pumped to dryness), one volume will suffice. Allow the well to recover to 75 percent of initial water level before sampling. Do not overfill purge containers because this increases the potential for spills and lifting injuries.
10. If sampling using a submersible pump, lower the pump intake to mid-screen (or the middle of the open section in uncased wells) and collect the sample. If sampling with a bailer, lower the bailer to just below the water surface.
11. For pump and packer assemblies only: Lower the assembly into the well so that the packer is positioned just above the screen or open section. Inflate the packer. Purge a volume equal to at least twice the screened interval (or unscreened open section volume below the packer) before sampling. Packers shall always be tested in a casing section above ground to determine proper inflation pressures for good sealing.
12. If the recovery time of the well is very slow (e.g., 24 hours or greater), sample collection can be delayed until the following day. If the well has been purged early in the morning, sufficient water may be standing in the well by the day's end to permit sample collection. If the well is incapable of producing a sufficient volume of sample at any time, take the largest quantity available and record

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this occurrence in the site logbook or equivalent electronic form. When this occurs, contact the analytical laboratory to alert them that a reduced sample volume(s) will be submitted for analysis.

13. Fill sample containers and preserve and label them as described in SOP SA-6.1. Many sample bottles will contain preservative when they are shipped to the field. In those cases, do not add preservative.
14. Replace the well cap and lock it as appropriate. Make sure the well is readily identifiable as the source of the sample.
15. Process sample containers as described in SOP SA-6.1.
16. Decontaminate equipment as described in SOP SA-7.1.

## **6.7 Low-Flow Purging and Sampling**

### **6.7.1 Scope and Application**

Low-flow purging and sampling techniques may be required for groundwater sampling activities. The purpose of low-flow purging and sampling is to collect groundwater samples that contain "representative" amounts of mobile organic and inorganic constituents in the vicinity of the selected open well interval, at or near natural flow conditions. This minimum-stress procedure emphasizes negligible water level drawdown and low pumping rates to collect samples with minimal alterations in water chemistry. This procedure is designed primarily to be used in wells with a casing diameter of 1 inch or more and a saturated screen length, or open interval, of 10 feet or less. Samples obtained are suitable for analyses of common types of groundwater contaminants (volatile and semivolatile organic compounds, pesticides, polychlorinated biphenyls [PCBs], metals and other inorganic ions [cyanide, chloride, sulfate, etc.]). This low-flow procedure is not designed for collection of non-aqueous phase liquid samples from wells containing light or dense non-aqueous phase liquids (LNAPLs or DNAPLs).

This procedure is flexible for various well construction types and groundwater yields. The goal of the procedure is to obtain a turbidity level of less than 10 NTUs and to achieve a water level drawdown of less than 0.3 foot during purging and sampling. If these goals cannot be achieved, sample collection can take place provided that the remaining criteria in this procedure are met.

### **6.7.2 Equipment**

The following equipment is required (as applicable) for low-flow purging and sampling:

- Adjustable rate submersible pump (e.g., centrifugal or bladder pump constructed of stainless steel or Teflon).
- Disposable clear plastic bottom-filling bailers to be used to check for and obtain samples of LNAPLs or DNAPLs.
- Tubing – Teflon, Teflon-lined polyethylene, polyethylene, polyvinyl chloride (PVC), Tygon, or stainless steel tubing can be used to collect samples for analysis, depending on the analyses to be performed and regulatory requirements.
- Water level measuring device with 0.01-foot accuracy (electronic devices are preferred for tracking water level drawdown during all pumping operations).

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- Interface probe.
- Flow measurement supplies.
- Power source (generator, nitrogen tank, etc.). If a gasoline generator is used, it must be located downwind and at a safe distance from the well so that the exhaust fumes do not contaminate the samples.
- Indicator parameter monitoring instruments – pH, turbidity, specific conductance, and temperature. Use of a flow-through cell is recommended. Optional indicators - ORP, salinity, and DO. A flow-through cell (also referred to as an in-line sample chamber) is required.
- Standards to perform field calibration of instruments.
- Decontamination supplies.
- Logbook(s) and other forms (see Attachments B through D) or equivalent electronic form(s).
- Sample bottles.
- Sample preservation supplies (as required by the analytical methods).
- Sample tags and/or labels.
- Well construction data, location map, field data from last sampling event (if available).
- Field Sampling Plan.
- PID or FID instrument for measuring volatile organic compounds (VOCs) per the HASP.

### **6.7.3 Purging and Sampling Procedure**

1. Open the monitoring well as stated earlier and step away. Prepare sampling equipment while allowing 3 to 5 minutes to allow the water level to reach equilibrium. In situations where VOCs are the primary contaminants of concern, air monitoring of the samplers' breathing zone areas may be required by the HASP (typically with a PID or FID).
2. Measure the water level immediately prior to placing the pump in the well and record the water level on the Low-Flow Purge Data Form or equivalent electronic form immediately prior to placing the pump or tubing into the well.
3. Lower the measuring device further into the well to collect the total depth measurement. Again wait 3 to 5 minutes to allow the well to equilibrate to the initial water level prior to placing the pump or pump intake in the well.
4. Record the total well depth on the Low-Flow Purge Data Form or equivalent electronic form immediately prior to placing the pump or tubing into the well
5. Lower the pump or tubing slowly into the well so that the pump intake is located at the center of the saturated screen length of the well. If possible, keep the pump intake at least 2 feet above the bottom of the well to minimize mobilization of sediment that may be present in the bottom of the well. Collection of turbidity-free water samples may be difficult if there is 3 feet or less of standing water in the well.

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6. Start with the initial pump rate set at approximately 0.1 liter per minute. Use a graduated cylinder and stopwatch to measure the pumping rate. Adjust the pumping rates as necessary to prevent drawdown from exceeding 0.3 foot during purging. If no drawdown is noted, the pump rate may be increased (to a maximum of 0.4 liter per minute) to expedite the purging and sampling event. The pump rate will be reduced if turbidity is greater than 10 NTUs after all other field parameters have stabilized. If groundwater is drawn down below the top of the well screen, purging shall cease or the well shall be pumped to dryness and then allowed to recover before purging continues. Well recovery to 75 percent is necessary prior to sampling. Slow-recovering wells should be identified and purged at the beginning of the workday to maximize field work efficiency. If possible, samples should be collected from these wells within the same workday and no later than 24 hours after the end of purging.
7. Measure the water level in the well every 5 to 10 minutes using the water level meter. Record the well water level on the Low Flow Purge Data Form (Attachment D) or equivalent electronic form.
8. Record on the Low Flow Purge Data Form every 5 to 10 minutes the water quality parameters (pH, specific conductance, temperature, turbidity, ORP, DO, and salinity or as specified by the approved site-specific planning document) measured by the water quality meter and turbidity meter. If the cell needs to be cleaned during purging operations, continue pumping (allow the pump to discharge into a container) and disconnect the cell. Rinse the cell with distilled/deionized water. After cleaning is completed, reconnect the flow-through cell and continue purging. Document the cell cleaning on the Low-Flow Purge Data Form or equivalent electronic form.
9. Estimate the flow rate by noting the amount of discharge in a graduated cylinder per unit time using a watch with a second hand. Remeasure the flow rate any time the pump rate is adjusted and periodically during purging. This will determine if a reduction in rate has occurred due to possible battery depletion.
10. During purging, check for the presence of bubbles in the flow-through cell. The presence of bubbles is an indication that connections are not tight. If bubbles are observed, check for loose connections and tighten, repair, or replace them as necessary to achieve a tight connection.
11. Wait until stabilization is achieved, or a minimum of two saturated screen volumes have been removed and three consecutive readings, taken at 5 to 10 minute intervals, are within the following limits, then begin sampling:
  - pH  $\pm 0.2$  standard units
  - Specific conductance  $\pm 10\%$
  - Temperature  $\pm 10\%$
  - Turbidity less than 10 NTUs
  - DO  $\pm 10\%$
12. If the above conditions have not been met after the well has been purged for 4 hours, purging will be considered complete and sampling can begin. Record the final well stabilization parameters from the Low-Flow Purge Data Form onto the Groundwater Sample Log Form or equivalent electronic form.

**NOTE:** VOC samples are preferably collected first, directly into pre-preserved sample containers. Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

13. If the water column in the pump tubing collapses (water does not completely fill the tubing) before exiting the tubing, use one of the following procedures to collect VOC samples:



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- Collect samples for non-VOC analyses first, then increase the flow rate incrementally until the water column completely fills the tubing, collect the sample for VOCs, and record the new flow rate.
- Reduce the diameter of the existing tubing until the water column fills the tubing either by adding a connector (Teflon or stainless steel) or clamp, which should reduce the flow rate by constricting the end of the tubing. Proceed with sample collection.
- Insert a narrow-diameter Teflon tube into the pump's tubing so that the end of the tubing is in the water column and the other end of the tubing protrudes beyond the pump's tubing, then collect the sample from the narrow diameter tubing.
- Prepare samples for shipping as per SOP SA-6.1.

## 7.0 REFERENCES

American Public Health Association, 1989. Standard Methods for the Examination of Water and Wastewater, 17th Edition, APHA, Washington, D.C.

Barcelona, M. J., J. P. Gibb and R. A. Miller, 1983. A Guide to the Selection of Materials for Monitoring Well Construction and Groundwater Sampling. ISWS Contract Report 327, Illinois State Water Survey, Champaign, Illinois.

Johnson Division, UOP, Inc. 1975. Ground Water and Wells, A Reference Book for the Water Well Industry. Johnson Division, UOP, Inc., Saint Paul, Minnesota.

Nielsen, D. M. and G. L. Yeates, 1985. A Comparison of Sampling Mechanisms Available for Small-Diameter Ground Water Monitoring Wells. Ground Water Monitoring Review 5:83-98.

Scalf, M. R., J. F. McNabb, W. J. Dunlap, R. L. Crosby and J. Fryberger, 1981. Manual of Ground Water Sampling Procedures. R. S. Kerr Environmental Research Laboratory, Office of Research and Development, U.S. EPA, Ada, Oklahoma.

U.S. EPA, 1979. Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020.

U.S. EPA, 1980. Procedures Manual for Ground Water Monitoring at Solid Waste Disposal Facilities. Office of Solid Waste, United States Environmental Protection Agency, Washington, D.C.

U.S. EPA, 1994. Groundwater Sampling Procedure - Low Flow Purge and Sampling (Draft Final). U.S. Environmental Protection Agency, Region I.

U.S. Geological Survey, 1984. National Handbook of Recommended Methods for Water Data Acquisition, Chapter 5: Chemical and Physical Quality of Water and Sediment. U.S. Department of the Interior, Reston, Virginia.

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**ATTACHMENT A**  
**PURGING EQUIPMENT SELECTION**

Diameter Casing		Bailer	Peristaltic Pump	Vacuum Pump	Air-lift	Diaphragm "Trash" Pump	Submersible Diaphragm Pump	Submersible Electric Pump	Submersible Electric Pump w/Packer
1.25-Inch	Water level <25 feet	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>			
	Water Level >25 feet	<b>X</b>			<b>X</b>				
2-Inch	Water level <25 feet	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>		
	Water Level >25 feet	<b>X</b>			<b>X</b>		<b>X</b>		
4-Inch	Water level <25 feet	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
	Water Level >25 feet	<b>X</b>			<b>X</b>		<b>X</b>	<b>X</b>	<b>X</b>
6-Inch	Water level <25 feet				<b>X</b>	<b>X</b>		<b>X</b>	<b>X</b>
	Water Level >25 feet				<b>X</b>			<b>X</b>	<b>X</b>
8-Inch	Water level <25 feet				<b>X</b>	<b>X</b>		<b>X</b>	<b>X</b>
	Water Level >25 feet				<b>X</b>			<b>X</b>	<b>X</b>

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**PURGING EQUIPMENT SELECTION**  
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Manufacturer	Model Name/Number	Principle of Operation	Maximum Outside Diameter/L. length (Inches)	Construction Materials (w/Lines and Tubing)	Lift Range (ft)	Delivery Rates or Volumes	1982 Price (Dollars)	Comments
BarCad Systems, Inc.	BarCad Sampler	Dedicated; gas drive (positive displacement)	1.5/16	PE, brass, nylon, aluminum oxide	0-150 with std. tubing	1 liter for each 10-15 feet of submergence	\$220-350	Requires compressed gas; custom sizes and materials available; acts as piezometer.
Cole-Parmer Inst. Co.	Master Flex 7570 Portable Sampling Pump	Portable; peristaltic (suction)	<1.0/NA	(not submersible) Tygon®, silicone Viton®	0-30	670 mL/min with 7015-20 pump head	\$500-600	AC/DC; variable speed control available; other models may have different flow rates.
ECO Pump Corp.	SAMPLifier	Portable; venturi	<1.5 or <2.0/NA	PP, PE, PVC, SS, Teflon®, Tefzel®	0-100	0-500 mL/min depending on lift	\$400-700	AC, DC, or gasoline-driven motors available; must be primed.
Geltek Corp.	Bailer 219-4	Portable; grab (positive displacement)	1.66/38	Teflon®	No limit	1,075 mL	\$120-135	Other sizes available.
GeoEngineering, Inc.	GEO-MONITOR	Dedicated; gas drive (positive displacement)	1.5/16	PE, PP, PVC, Viton®	Probably 0-150	Approximately 1 liter for each 10 feet of submergence	\$185	Acts as piezometer; requires compressed gas.
Industrial and Environmental Analysts, Inc. (IEA)	Aquarius	Portable; bladder (positive displacement)	1.75/43	SS, Teflon®, Viton®	0-250	0-2,800 mL/min	\$1,500-3,000	Requires compressed gas; other models available; AC, DC, manual operation possible.
IEA	Syringe Sampler	Portable; grab (positive displacement)	1.75/43	SS, Teflon®	No limit	850 mL sample volume	\$1,100	Requires vacuum and/or pressure from hand pump.
Instrument Specialties Co. (ISCO)	Model 2600 Well Sampler	Portable; bladder (positive displacement)	1.75/50	PC, silicone, Teflon®, PP, PE, Detrin®, acetal	0-150	0-7,500 mL/min	\$990	Requires compressed gas (40 psi minimum).
Keck Geophysical Instruments, Inc.	SP-81 Submersible Sampling Pump	Portable; helical rotor (positive displacement)	1.75/25	SS, Teflon®, PP, EPDM, Viton®	0-160	0-4,500 mL/min	\$3,500	DC operated.
Leonard Mold and Die Works, Inc.	GeoFilter Small Diameter Well Pump (#05000)	Portable; bladder (positive displacement)	1.75/38	SS, Teflon®, PC, Neoprene®	0-400	0-3,500 mL/min	\$1,400-1,500	Requires compressed gas (55 psi minimum); pneumatic or AC/DC control module.
Oil Recovery Systems, Inc.	Surface Sampler	Portable; grab (positive displacement)	1.75/12	acrylic, Detrin®	No limit	Approximately 250 mL	\$125-160	Other materials and models available; for measuring thickness of "floating" contaminants.
Q.E.D. Environmental Systems, Inc.	Well Wizard® Monitoring System (P-100)	Dedicated; bladder (positive displacement)	1.66/36	PVC	0-230	0-2,000 mL/min	\$300-400	Requires compressed gas; piezometric level indicator; other materials available.

**ATTACHMENT A**  
**PURGING EQUIPMENT SELECTION**  
**PAGE 3**

Manufacturer	Model Name/Number	Principle of Operation	Maximum Outside Diameter/L length (Inches)	Construction Materials (w/Lines and Tubing)	Lift Range (ft)	Delivery Rates or Volumes	1982 Price (Dollars)	Comments
Randolph Austin Co.	Model 500 Vari-Flow Pump	Portable; (suction)	<0.5/NA	(Not submersible) Rubber, Tygon®, or Neoprene®	0-30	See comments	\$1,200-1,300	Flow rate dependent on motor and tubing selected; AC operated; other models available.
Robert Co.	Model 180	Portable; (positive displacement)	1.8/22	SS, Teflon®, Delrin® PP, Viton®, acrylic, PE	0-500	0-1,800 mL/min	\$2,600-2,700	Requires compressed gas; water level indicator and flow meter; custom models available.
Slope Indicator Co. (SINCO)	Model 514124 Pneumatic Water Sampler	Portable; gas drive (positive displacement)	1.9/18	PVC, nylon	0-1,100	250 mL/flushing cycle	\$250-350	Requires compressed gas; SS available; piezometer model available; dedicated model available.
Solinst Ltd.	Canada 5W Sampler	Portable; (positive displacement)	1.9/27	PVC, brass, nylon, Neoprene®	0-330	500 mL	\$1,300-1,800	Requires compressed gas; custom models available.
TIMCO Mfg. Co., Inc.	Std. Bailer	Portable; (positive displacement)	1.66/Custom	PVC, PP	No limit	250 mL/ft of bailer	\$20-60	Other sizes, materials, models available; optional bottom-emptying device available; no solvents used.
TIMCO	Air or Gas Lift Sampler	Portable; gas drive (positive displacement)	1.66/30	PVC, Tygon®, Teflon®	0-150	350 mL/flushing cycle	\$100-200	Requires compressed gas; other sizes, materials, models available; no solvents used.
Tole Devices Co.	Sampling Pump	Portable; (positive displacement)	1.38/48	SS, silicone, Delrin®, Tygon®	0-125	0-4,000 mL/min	\$800-1,000	Compressed gas required; DC control module; custom built.

## Construction Material Abbreviations:

PE Polyethylene  
 PP Polypropylene  
 PVC Polyvinyl chloride  
 SS Stainless steel  
 PC Polycarbonate  
 EPDM Ethylene-propylene diene (synthetic rubber)

## Other Abbreviations:

NA Not applicable  
 AC Alternating current  
 DC Direct current

NOTE: Other manufacturers market pumping devices which could be used for groundwater sampling, though not expressly designed for this purpose. The list is not meant to be all-inclusive and listing does not constitute endorsement for use. Information in the table is from sales literature and/or personal communication. No skimmer, scavenger-type, or high-capacity pumps are included.

Source: Barcelona et al., 1983.



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**ATTACHMENT B**  
**GROUNDWATER SAMPLE LOG SHEET**

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[illegible]







TETRA TECH

# STANDARD OPERATING PROCEDURES

Number

SA-2.5

Page

1 of 6

Effective Date

01/2012

Revision

4

Applicability

Tetra Tech, Inc.

Prepared

Earth Sciences Department

Subject

DIRECT PUSH TECHNOLOGY  
(GEOPROBE®/HYDROPUNCH™)

Approved

J. Zimmerly

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## **1.0 PURPOSE**

The purpose of this procedure is to provide general reference information on Direct Push Technology (DPT). DPT is designed to collect soil, groundwater, and soil gas samples without using conventional drilling techniques. The advantage of using DPT over conventional drilling includes the generation of little or no drill cuttings, sampling in locations with difficult accessibility, reduced overhead clearance requirements, no fluid introduction during probing, and typical lower costs per sample than with conventional techniques. Disadvantages include a maximum penetration depth of approximately 15 to 40 feet in dense soils (although it may be as much as 60 to 80 feet in certain types of geological environments), reduced capability of obtaining accurate water-level measurements, and the inability to install permanent groundwater monitoring wells. The methods and equipment described herein are for collection of surface and subsurface soil samples and groundwater samples. Soil gas sampling is discussed in SOP SA-2.4.

## **2.0 SCOPE**

This procedure provides information on proper sampling equipment and techniques for DPT. Review of the information contained herein will facilitate planning of the field sampling effort by describing standard sampling techniques. The techniques described shall be followed whenever applicable, noting that site-specific conditions or project-specific plans may require adjustments in methodology.

## **3.0 GLOSSARY**

Direct Push Technology (DPT) - DPT refers to sampling tools and sensors that are driven directly into the ground without the use of conventional drilling equipment. DPT typically utilizes hydraulic pressure and/or percussion hammers to advance the sampling tools. A primary advantage of DPT over conventional drilling techniques is that DPT results in the generation of little or no investigation derived waste.

Geoprobe7 - Geoprobe7 is a manufacturer of a hydraulically-powered, percussion/probing machines utilizing DPT to collect subsurface environmental samples. Geoprobe7 relies on a relatively small amount of static weight (vehicle) combined with percussion as the energy for advancement of a tool string. The Geoprobe7 equipment can be mounted in a multitude of vehicles for access to all types of environmental sites.

HydroPunch® - HydroPunch® is a manufacturer of stainless steel and Teflon7 sampling tools that are capable of collecting representative groundwater and/or soil samples without requiring the installation of a groundwater monitoring well or conventional soil boring. HydroPunch® is an example of DPT sampling equipment.

Flame Ionization Detector (FID) - A portable instrument for the measurement of many combustible organic compounds and a few inorganic compounds in air at parts-per million levels. The basis for the detection is the ionization of gaseous species utilizing a flame as the energizing source.

Photo Ionization Detector (PID) - A portable instrument for the measurement of many combustible organic compounds and a few inorganic compounds in air at parts-per million levels. The basis for the detection is the ionization of gaseous species utilizing ultraviolet radiation as the energizing source.

## **4.0 RESPONSIBILITIES**

Project Manager - The Project Manager is responsible for selecting and/or reviewing the appropriate DPT drilling procedure required to support the project objectives.

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**Field Operations Leader (FOL)**- The FOL is primarily responsible for performing the DPT in accordance with the project-specific plan.

## **5.0 SOIL SAMPLING PROCEDURES**

### **5.1 General**

The common methodology for the investigation of the vadose zone is soil boring drilling and soil sampling. However, drilling soil borings can be very expensive. Generally the advantage of DPT for subsurface soil sampling is the reduced cost of disposal of drilling cuttings and shorter sampling times.

### **5.2 Sampling Equipment**

Equipment needed for conducting DPT drilling for subsurface soil sampling includes, but is not limited to, the following:

- Geoprobe® Sampling Kit
- Cut-resistant gloves
- 4-foot x 1.5-inch diameter macrocore sampler
- Probe sampling adapters
- Roto-hammer with 1.5-inch bit
- Disposable acetate liners for soil macrocore sampler
- Cast aluminum or steel drive points
- Geoprobe® AT-660 Series Large Bore Soil Sampler, or equivalent
- Standard decontamination equipment and solutions

For health and safety equipment and procedures, follow the direction provided in the Safe Work Permit in Attachment 1, or the more detailed directions provided in the project's Health and Safety Plan.

### **5.3 DPT Sampling Methodology**

There are several methods for the collection of soil samples using DPT drilling. The most common method is discussed in the following section. Variations of the following method may be conducted upon approval of the Project Manager in accordance with the project-specific plan.

- Macrocore samplers fitted with detachable aluminum or steel drive points are driven into the ground using hydraulic pressure. If there is concrete or pavement over a sampling location, a Roto-hammer is used to drill a minimum 1.5-inch diameter hole through the surface material. A Roto-hammer may also be used if very dense soils are encountered.
- The sampler is advanced continuously in 4-foot intervals or less if desired. No soil cuttings are generated because the soil which is not collected in the sampler is displaced within the formation.
- The sampler is retracted from the hole, and the 4-foot continuous sample is removed from the outer coring tube. The sample is contained within an inner acetate liner.
- Attach the metal trough from the Geoprobe® Sampling Kit firmly to the tail gate of a vehicle. If a vehicle with a tail gate is not available, secure the trough on another suitable surface.
- Place the acetate liner containing the soils in the trough.

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- While wearing cut-resistant gloves (constructed of leather or other suitable material), cut the acetate liner through its entire length using the double-bladed knife that accompanies the Geoprobe® Sampling Kit. Then remove the strip of acetate from the trough to gain access to the collected soils. Do not attempt to cut the acetate liner while holding it in your hand. *Don 2/17/12*
- Field screen the sample with an FID or PID, and observe/examine the sample (according to SOP GH-1.3). If appropriate, transfer the sample to sample bottles for laboratory analysis. If additional volume is required, push an additional boring adjacent to the first and composite/mix the same interval. Field compositing is usually not acceptable for sample requiring volatile organics analysis.
- Once sampling has been completed, the hole is backfilled with bentonite chips or bentonite cement grout, depending upon project requirements. Asphalt or concrete patch is used to cap holes through paved or concrete areas. All holes should be finished smooth to existing grade.
- In the event the direct push van/truck cannot be driven to a remote location or a sampling location with difficult accessibility, sampling probes may be advanced and sampled manually or with air/electric operated equipment (e.g., jack hammer).
- Sampling equipment is decontaminated prior to collecting the next sample.

## **6.0 GROUNDWATER SAMPLING PROCEDURES**

### **6.1 General**

The most common methodology for the investigation of groundwater is the installation and sampling of permanent monitoring wells. If only groundwater screening is required, the installation and sampling of temporary well points may be performed. The advantage of temporary well point installation using DPT is reduced cost due to no or minimal disposal of drilling cuttings and well construction materials, and shorter installation/times sampling.

Two disadvantages of DPT drilling for well point installation are:

- In aquifers with low yields, well points may have to be sampled without purging or development.
- If volume requirements are high, this method can be time consuming for low yield aquifers.

### **6.2 Sampling Equipment**

Equipment needed for temporary well installation and sampling using DPT includes, but is not limited, to the following:

- 2-foot x 1-inch diameter mill-slotted (0.005 to 0.02-inch) well point
- Connecting rods
- Roto-hammer with 1.5-inch bit
- Mechanical jack
- 1/4-inch OD polyethylene tubing
- 3/8-inch OD polyethylene tubing
- Peristaltic pump
- Standard decontamination equipment and solutions

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### **6.3      DPT Temporary Well Point Installation and Sampling Methodology**

There are several methods for the installation and sampling of temporary well points using DPT. The most common methodology is discussed below. Variations of the following method may be conducted upon approval of the Project Manager in accordance with the project specific plan.

- A 2-foot x 1-inch diameter mill-slotted (0.005 to 0.02-inch) well point attached to connecting rods is driven into the ground to the desired depth using a rotary electric hammer or other direct push drill rig. If there is concrete or pavement over a sampling location, a Roto-hammer or electric coring machine is used to drill a hole through the surface material.
- The well point will be allowed to equilibrate for at least 15 minutes, after which a measurement of the static water level will be taken. The initial measurement of the water level will be used to assess the amount of water which is present in the well point and to determine the amount of silt and sand infiltration that may have occurred.
- The well point will be developed using a peristaltic pump and polyethylene tubing to remove silt and sand which may have entered the well point. The well point is developed by inserting polyethylene tubing to the bottom of the well point and lifting and lowering the tubing slightly while the pump is operating. The pump will be operated at a maximum rate of approximately 2 liters per minute. After removal of sediment from the bottom of the well point, the well point will be vigorously pumped at maximum capacity until discharge water is visibly clear and no further sediments are being generated. Measurements of pH, specific conductance, temperature, and turbidity shall be recorded every 5 to 10 minutes during the purging process. After two consistent readings of pH, specific conductance, temperature and turbidity (±10 percent), the well may be sampled.
- A sample will be collected using the peristaltic pump set at the same or reduced speed as during well development. Samples (with the exception of the samples to be analyzed for volatile organic compounds, VOCs) will be collected directly from the pump discharge. Sample containers for VOCs will be filled by (first shutting off the pump) crimping the discharge end of the sample tubing when filled, removing the inlet end of the sample tubing from the well, suspending the inlet tubing above the vial, and allowing water to fill each vial by gravity flow.
- Once the groundwater sample has been collected, the connecting rods and well point will be removed from the hole with the direct push rig hydraulics. The hole will be backfilled with bentonite chips or bentonite cement grout, depending upon project requirements. Asphalt or concrete patch will be used to cap holes through paved or concrete areas. All holes will be finished smooth to existing grade.
- In the event the direct push van/truck cannot be driven to a remote location or sampling location with difficult accessibility, sampling probes may be advanced and sampled manually or with air/electric-operated equipment (e.g., jack hammer).
- Decontaminate the equipment before moving to the next location.

### **7.0      RECORDS**

A record of all field procedures, tests, and observations must be recorded in the field logbook, boring logs, and sample log sheets, as needed. Entries should include all pertinent data regarding the investigation. The use of sketches and field landmarks will help to supplement the investigation and evaluation.

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**ATTACHMENT 1  
SAFE WORK PERMIT FOR DPT OPERATIONS**

Permit No. \_\_\_\_\_ Date: \_\_\_\_\_ Time: From \_\_\_\_\_ to \_\_\_\_\_

**SECTION I: General Job Scope**

- I. Work limited to the following (description, area, equipment used): **Monitoring well drilling and installation through direct push technology**
- II. Required Monitoring Instruments: \_\_\_\_\_
- III. Field Crew: \_\_\_\_\_
- IV. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector \_\_\_\_\_

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**SECTION II: General Safety Requirements (To be filled in by permit issuer)**

- |  |  |
|--|--|
| V. Protective equipment required   | Respiratory equipment required           |
| Level D <input checked="" type="checkbox"/> Level B <input type="checkbox"/> | Full face APR <input type="checkbox"/>   |
| Level C <input type="checkbox"/> Level A <input type="checkbox"/>            | Half face APR <input type="checkbox"/>   |
| Detailed on Reverse  | SKA-PAC SAR <input type="checkbox"/>     |
|  | Skid Rig <input type="checkbox"/>        |
|  | Escape Pack <input type="checkbox"/>     |
|  | SCBA <input type="checkbox"/>            |
|  | Bottle Trailer <input type="checkbox"/>  |
|  | None <input checked="" type="checkbox"/> |

Level D Minimum Requirements: Sleeved shirt and long pants, safety footwear, and work gloves. Safety glasses, hard hats, and hearing protection will be worn when working near or sampling in the vicinity of the DPT rig.

**Modifications/Exceptions.**

VI. Chemicals of Concern	Action Level(s)	Response Measures
--------------------------	-----------------	-------------------

**VII. Additional Safety Equipment/Procedures**

- |   |   |  |
|---|---|--|
| Hard-hat.....   | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Hearing Protection (Plugs/Muffs) <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |
| Safety Glasses .....  | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Safety belt/harness <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No              |
| Chemical/splash goggles.....  | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | Radio <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No                            |
| Splash Shield.....  | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | Barricades <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No                       |
| Splash suits/coveralls .....  | <input type="checkbox"/> Yes <input type="checkbox"/> No            | Gloves (Type - _____) <input type="checkbox"/> Yes <input type="checkbox"/> No                       |
| Steel toe Work shoes or boots <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |   | Work/warming regimen <input type="checkbox"/> Yes <input type="checkbox"/> No                        |

Modifications/Exceptions: Reflective vests for high traffic areas.

**VIII. Procedure review with permit acceptors**

- |  |                                     |                                     |                         |                          |
|--|-------------------------------------|-------------------------------------|-------------------------|--------------------------|
|  | Yes                                 | NA                                  | Yes                     | NA                       |
| Safety shower/eyewash (Location & Use) .....   | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | Emergency alarms .....  | <input type="checkbox"/> |
| Daily tail gate meetings.....                  | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Evacuation routes ..... | <input type="checkbox"/> |
| Contractor tools/equipment/PPE inspected ..... | <input type="checkbox"/>            | <input type="checkbox"/>            | Assembly points.....    | <input type="checkbox"/> |

**IX. Site Preparation**

- |   |  |
|---|--|
| Utility Clearances obtained for areas of subsurface investigation | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Physical hazards removed or blockaded                             | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Site control boundaries demarcated/signage                        | <input type="checkbox"/> Yes <input type="checkbox"/> No |

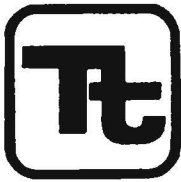
**X. Equipment Preparation**

- |  |                          |                                     |
|--|--------------------------|-------------------------------------|
|  | Yes                      | NA                                  |
| Equipment drained/depressurized.....                       | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| Equipment purged/cleaned.....                              | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| Isolation checklist completed .....                        | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| Electrical lockout required/field switch tested .....      | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| Blinds/misalignments/blocks & bleeds in place.....         | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| Hazardous materials on walls/behind liners considered..... | <input type="checkbox"/> | <input checked="" type="checkbox"/> |

- XI. Additional Permits required (Hot work, confined space entry). ☐ Yes ☐ No  
If yes, complete permit required or contact Health Sciences, Pittsburgh Office

**XII. Special instructions, precautions:**

Permit Issued by: \_\_\_\_\_ Permit Accepted by: \_\_\_\_\_



TETRA TECH

# STANDARD OPERATING PROCEDURES

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Effective Date	01/2012	Revision	4
Applicability	Tetra Tech, Inc.		
Prepared	Earth Sciences Department		
Approved	J. Zimmerly		

Subject  
NON-RADIOLOGICAL SAMPLE HANDLING

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6/12/12



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## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide information on sample preservation, packaging, and shipping procedures to be used in handling environmental samples submitted for chemical constituent, biological, or geotechnical analysis. Sample chain-of-custody procedures and other aspects of field documentation are addressed in SOP SA-6.3. Sample identification is addressed in SOP CT-04.

## 2.0 SCOPE

This procedure describes the appropriate containers to be used for samples depending on the analyses to be performed, and the steps necessary to preserve the samples when shipped off site for chemical analysis.

## 3.0 GLOSSARY

**Hazardous Material** - A substance or material which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated. Under 49 CFR, the term includes hazardous substances, hazardous wastes, marine pollutants, and elevated temperature materials, as well as materials designated as hazardous under the provisions of §172.101 and §172.102 and materials that meet the defining criteria for hazard classes and divisions in Part 173. With slight modifications, IATA has adopted DOT "hazardous materials" as IATA "Dangerous Goods."

**Hazardous Waste** - Any substance listed in 40 CFR, Subpart D (y261.30 et seq.), or otherwise characterized as ignitable, corrosive, reactive, or toxic (as defined by Toxicity Characteristic Leaching Procedure, TCLP, analysis) as specified under 40 CFR, Subpart C (y261.20 et seq.), that would be subject to manifest requirements specified in 40 CFR 262. Such substances are defined and regulated by EPA.

**Marking** - A descriptive name, identification number, instructions, cautions, weight, specification or UN marks, or combination thereof required on outer packaging of hazardous materials.

**n.o.i** - Not otherwise indicated (may be used interchangeably with n.o.s.).

**n.o.s.** - Not otherwise specified.

**Packaging** - A receptacle and any other components or materials necessary for compliance with the minimum packaging requirements of 49 CFR 174, including containers (other than freight containers or overpacks), portable tanks, cargo tanks, tank cars, and multi-unit tank-car tanks to perform a containment function in conformance with the minimum packaging requirements of 49 CFR 173.24(a) & (b).

**Placard** - Color-coded, pictorial sign which depicts the hazard class symbol and name and which is placed on the side of a vehicle transporting certain hazardous materials.

### Common Preservatives:

- Hydrochloric Acid - HCl
- Sulfuric Acid - H<sub>2</sub>SO<sub>4</sub>
- Nitric Acid - HNO<sub>3</sub>
- Sodium Hydroxide - NaOH

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#### Other Preservatives

- Zinc Acetate
- Sodium Thiosulfate -  $\text{Na}_2\text{S}_2\text{O}_3$

Normality (N) - Concentration of a solution expressed as equivalent per liter, an equivalent being the amount of a substance containing 1 gram-atom of replaceable hydrogen or its equivalent.

Reportable Quantity (RQ) - For the purposes of this SOP, means the quantity specified in column 3 of the Appendix to DOT 49 CFR §172.101 for any material identified in column 1 of the appendix. A spill greater than the amount specified must be reported to the National Response Center.

Sample - A sample is physical evidence collected from a facility or the environment, which is representative of conditions at the location and time of collection.

#### **4.0 RESPONSIBILITIES**

Field Operations Leader - Directly responsible for the bottling, preservation, labeling, packaging, shipping, and custody of samples up to and including release to the shipper.

Field Samplers - Responsible for initiating the Chain-of-Custody Record (per SOP SA-6.3), implementing the packaging and shipping requirements, and maintaining custody of samples until they are relinquished to another custodian or to the shipper.

#### **5.0 PROCEDURES**

Sample identification, labeling, documentation, and chain-of-custody are addressed by SOP SA-6.3.

##### **5.1 Sample Containers**

Different types of chemicals react differently with sample containers made of various materials. For example, trace metals adsorb more strongly to glass than to plastic, whereas many organic chemicals may dissolve various types of plastic containers. Attachments A and B show proper containers (as well as other information) per 40 CFR 136. In general, the sample container shall allow approximately 5-10 percent air space ("ullage") to allow for expansion/vaporization if the sample warms during transport. However, for collection of volatile organic compounds, head space shall be omitted. The analytical laboratory will generally provide certified-clean containers for samples to be analyzed for chemical constituents. Shelby tubes or other sample containers are generally provided by the driller for samples requiring geotechnical analysis. Sufficient lead time shall be allowed for a delivery of sample container orders. Therefore, it is critical to use the correct container to maintain the integrity of the sample prior to analysis.

Once opened, the container must be used at once for storage of a particular sample. Unused but opened containers are to be considered contaminated and must be discarded. Because of the potential for introduction of contamination, they cannot be reclosed and saved for later use. Likewise, any unused containers which appear contaminated upon receipt, or which are found to have loose caps or a missing Teflon liner (if required for the container), shall be discarded.

##### **5.2 Sample Preservation**

Many water and soil samples are unstable and therefore require preservation to prevent changes in either the concentration or the physical condition of the constituent(s) requiring analysis. Although complete



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and irreversible preservation of samples is not possible, preservation does retard the chemical and biological changes that inevitably take place after the sample is collected. Preservation techniques are usually limited to pH control, chemical addition(s), and refrigeration/ freezing (certain biological samples only).

### 5.2.1 Overview

The preservation techniques to be used for various analytes are listed in Attachments A and B. Reagents required for sample preservation will either be added to the sample containers by the laboratory prior to their shipment to the field or be added in the field (in a clean environment). Only high purity reagents shall be used for preservation. In general, aqueous samples of low-concentration organics (or soil samples of low- or medium-concentration organics) are cooled to 4EC. Medium-concentration aqueous samples, high-hazard organic samples, and some gas samples are typically not preserved. Low-concentration aqueous samples for metals are acidified with HNO<sub>3</sub>, whereas medium-concentration and high-hazard aqueous metal samples are not preserved. Low- or medium-concentration soil samples for metals are cooled to 4EC, whereas high-hazard samples are not cooled.

The following subsections describe the procedures for preparing and adding chemical preservatives. Attachments A and B indicate the specific analytes which require these preservatives.

The FOL is responsible for ensuring that an accurate Chemical Inventory is created and maintained for all hazardous chemicals brought to the work site (see Section 5 of the TtNUS Health and Safety Guidance Manual). Furthermore, the FOL must ensure that a corresponding Material Safety Data Sheet (MSDS) is collected for every substance entered on the site Chemical Inventory, and that all persons using/handling/ disposing of these substances review the appropriate MSDS for substances they will work with. The Chemical Inventory and the MSDSs must be maintained at each work site in a location and manner where they are readily-accessible to all personnel.

### 5.2.2 Preparation and Addition of Reagents

Addition of the following acids or bases may be specified for sample preservation; these reagents shall be analytical reagent (AR) grade or purer and shall be diluted to the required concentration with deionized water before field sampling commences. To avoid uncontrolled reactions, be sure to Add Acid to water (not vice versa). A dilutions guide is provided below.

Acid/Base	Dilution	Concentration	Estimated Amount Required for Preservation
Hydrochloric Acid (HCl)	1 part concentrated HCl: 1 part double-distilled, deionized water	6N	5-10 mL
Sulfuric Acid (H <sub>2</sub> SO <sub>4</sub> )	1 part concentrated H <sub>2</sub> SO <sub>4</sub> : 1 part double-distilled, deionized water	18N	2 - 5 mL
Nitric Acid (HNO <sub>3</sub> )	Undiluted concentrated HNO <sub>3</sub>	16N	2 - 5 mL
Sodium Hydroxide (NaOH)	400 grams solid NaOH dissolved in 870 mL double-distilled, deionized water; yields 1 liter of solution	10N	2 mL

The amounts required for preservation shown in the above table assumes proper preparation of the preservative and addition of the preservative to one liter of aqueous sample. This assumes that the sample is initially at pH 7, is poorly buffered, and does not contain particulate matter; as these conditions

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vary, more preservative may be required. Consequently, the final sample pH must be checked using narrow-range pH paper, as described in the generalized procedure detailed below:

- Pour off 5-10 mL of sample into a dedicated, clean container. Use some of this sample to check the initial sample pH using wide range (0-14) pH paper. Never dip the pH paper into the sample; always apply a drop of sample to the pH paper using a clean stirring rod or pipette.
- Add about one-half of the estimated preservative required to the original sample bottle. Cap and invert gently several times to mix. Check pH (as described above) using medium range pH paper (pH 0-6 or pH 7.5-14, as applicable).
- Cap sample bottle and seal securely.

Additional considerations are discussed below:

- To test if ascorbic acid must be used to remove oxidizing agents present in the sample before it can be properly preserved, place a drop of sample on KI-starch paper. A blue color indicates the need for ascorbic acid addition.

If required, add a few crystals of ascorbic acid to the sample and retest with the KI-starch paper. Repeat until a drop of sample produces no color on the KI-starch paper. Then add an additional 0.6 grams of ascorbic acid per each liter of sample volume.

Continue with proper base preservation of the sample as described above.

- Samples for sulfide analysis must be treated by the addition of 4 drops (0.2 mL) of 2N zinc acetate solution per 100 ml of sample.

The 2N zinc acetate solution is made by dissolving 220 grams of zinc acetate in 870 mL of double-distilled, deionized water to make 1 liter of solution.

The sample pH is then raised to 9 using the NaOH preservative.

- Sodium thiosulfate must be added to remove residual chlorine from a sample. To test the sample for residual chlorine use a field test kit specially made for this purpose.

If residual chlorine is present, add 0.08 grams of sodium thiosulfate per liter of sample to remove the residual chlorine.

Continue with proper acidification of the sample as described above.

For biological samples, 10% buffered formalin or isopropanol may also be required for preservation. Questions regarding preservation requirements should be resolved through communication with the laboratory before sampling begins.

### ~~5.3~~ Field Filtration

At times, field-filtration may be required to provide for the analysis of dissolved chemical constituents. Field-filtration must be performed prior to the preservation of samples as described above. General procedures for field filtration are described below:

- The sample shall be filtered through a non-metallic, 0.45-micron membrane filter, immediately after collection. The filtration system shall consist of dedicated filter canister, dedicated tubing, and a

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~~peristaltic pump with pressure or vacuum pumping squeeze action (since the sample is filtered by mechanical peristalsis, the sample travels only through the tubing).~~ *6/12/12*

- ~~To perform filtration, thread the tubing through the peristaltic pump head. Attach the filter canister to the discharge end of the silicon tubing (note flow direction arrow); attach the aqueous sample container to the intake end of the silicon tubing. Turn the peristaltic pump on and perform filtration. Run approximately 100 ml of sample through the filter and discard prior to sample collection.~~
- ~~Continue by preserving the filtrate (contained in the filter canister), as applicable and generally described above.~~

#### **5.4 Sample Packaging and Shipping**

Only employees who have successfully completed the TtNUS "Shipping Hazardous Materials" training course are authorized to package and ship hazardous substances. These trained individuals are responsible for performing shipping duties in accordance with this training.

Samples collected for shipment from a site shall be classified as either environmental or hazardous material samples. Samples from drums containing materials other than Investigative Derived Waste (IDW) and samples obtained from waste piles or bulk storage tanks are generally shipped as hazardous materials. A distinction must be made between the two types of samples in order to:

- Determine appropriate procedures for transportation of samples (if there is any doubt, a sample shall be considered hazardous and shipped accordingly.)
- Protect the health and safety of transport and laboratory personnel receiving the samples (special precautions are used by the shipper and at laboratories when hazardous materials are received.)

Detailed procedures for packaging environmental samples are outlined in the remainder of this section.

##### **5.4.1 Environmental Samples**

Environmental samples are packaged as follows:

- Place properly identified sample container, with lid securely fastened, in a plastic bag (e.g. Ziploc baggie), and seal the bag.
- Place sample in a cooler constructed of sturdy material which has been lined with a large, plastic bag (e.g. "garbage" bag). Drain plugs on coolers must be taped shut.
- Pack with enough cushioning materials such as bubble wrap (shoulders of bottles must be iced if required) to minimize the possibility of the container breaking.
- If cooling is required (see Attachments A and B), place ice around sample container shoulders, and on top of packing material (minimum of 8 pounds of ice for a medium-size cooler).
- Seal (i.e., tape or tie top in knot) large liner bag.
- The original (top, signed copy) of the COC form shall be placed inside a large Ziploc-type bag and taped inside the lid of the shipping cooler. If multiple coolers are sent but are included on one COC form, the COC form should be sent with the cooler containing the vials for VOC analysis. The COC form should then state how many coolers are included with that shipment.

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- Close and seal outside of cooler as described in SOP SA-6.3. Signed custody seals must be used.

Coolers must be marked as containing "Environmental Samples." The appropriate side of the container must be marked "This End Up" and arrows placed appropriately. No DOT marking or labeling is required; there are no DOT restrictions on mode of transportation.

## 6.0 REFERENCES

American Public Health Association, 1981. Standard Methods for the Examination of Water and Wastewater, 15th Edition. APHA, Washington, D.C.

International Air Transport Association (latest issue). Dangerous Goods Regulations, Montreal, Quebec, Canada.

U.S. Department of Transportation (latest issue). Hazardous Materials Regulations, 49 CFR 171-177.

U.S. EPA, 1984. "Guidelines Establishing Test Procedures for the Analysis of Pollutants under Clean Water Act." Federal Register, Volume 49 (209), October 26, 1984, p. 43234.

U.S. EPA, 1979. Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020, U.S. EPA-EMSL, Cincinnati, Ohio.

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## ATTACHMENT A

### GENERAL SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS

Sample Type and Concentration	Container <sup>(1)</sup>	Sample Size	Preservation <sup>(2)</sup>	Holding Time <sup>(2)</sup>
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#### WATER

Organics (GC&GC/MS)	VOC	Low	Borosilicate glass	2 x 40 mL	Cool to 4EC HCl to # 2	14 days <sup>(9)</sup>
	Extractables SVOCs and pesticide/PCBs)	(Low)	Amber glass	2x2 L or 4x1 L	Cool to 4EC	7 days to extraction; 40 days after extraction
	Extractables SVOCs and pesticide/PCBs)	(Medium)	Amber glass	2x2 L or 4x1 L	None	7 days to extraction; 40 days after extraction
Inorganics	Metals	Low	High-density polyethylene	1 L	HNO <sub>3</sub> to pH #2	6 months (Hg-28 days)
		Medium	Wide-mouth glass	16 oz.	None	6 months
	Cyanide	Low	High-density polyethylene	1 L	NaOH to pH>12	14 days
	Cyanide	Medium	Wide-mouth glass	16 oz.	None	14 days
Organic/ Inorganic	High Hazard		Wide-mouth glass	8 oz.	None	14 days

#### SOIL

Organics (GC&GC/MS)	VOC		EnCore Sampler	(3) 5 g Samplers	Cool to 4EC	48 hours to lab preservation
	Extractables SVOCs and pesticides/PCBs)	(Low)	Wide-mouth glass	8 oz.	Cool to 4EC	14 days to extraction; 40 days after extraction
	Extractables SVOCs and pesticides/PCBs)	(Medium)	Wide-mouth glass	8 oz.	Cool to 4EC	14 days to extraction; 40 days after extraction
Inorganics	Low/Medium		Wide-mouth glass	8 oz.	Cool to 4EC	6 months (Hg - 28 days) Cyanide (14 days)
Organic/Inorga nic	High Hazard		Wide-mouth glass	8 oz.	None	NA
Dioxin/Furan	All		Wide-mouth glass	4 oz.	None	35 days until extraction; 40 days after extraction
TCLP	All		Wide-mouth glass	8 oz.	None	7 days until preparation; analysis as per fraction

#### AIR

Volatile Organics	Low/Medium		Charcoal tube -- 7 cm long, 6 mm OD, 4 mm ID	100 L air	Cool to 4EC	5 days recommended
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1 All glass containers should have Teflon cap liners or septa.

2 See Attachment E. Preservation and maximum holding time allowances per 40 CFR 136.

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## ATTACHMENT B

### ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES

Parameter Number/Name	Container <sup>(1)</sup>	Preservation <sup>(2)(3)</sup>	Maximum Holding Time <sup>(4)</sup>
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#### INORGANIC TESTS:

Acidity	P, G	Cool, 4EC	14 days
Alkalinity	P, G	Cool, 4EC	14 days
Ammonia - Nitrogen	P, G	Cool, 4EC; H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Biochemical Oxygen Demand (BOD)	P, G	Cool, 4EC	48 hours
Bromide	P, G	None required	28 days
Chemical Oxygen Demand (COD)	P, G	Cool, 4EC; H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Chloride	P, G	None required	28 days
Chlorine, Total Residual	P, G	None required	Analyze immediately
Color	P, G	Cool, 4EC	48 hours
Cyanide, Total and Amenable to Chlorination	P, G	Cool, 4EC; NaOH to pH 12; 0.6 g ascorbic acid <sup>(5)</sup>	14 days <sup>(6)</sup>
Fluoride	P	None required	28 days
Hardness	P, G	HNO <sub>3</sub> to pH 2; H <sub>2</sub> SO <sub>4</sub> to pH 2	6 months
Total Kjeldahl and Organic Nitrogen	P, G	Cool, 4EC; H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Nitrate - Nitrogen	P, G	None required	48 hours
Nitrate-Nitrite - Nitrogen	P, G	Cool, 4EC; H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Nitrite - Nitrogen	P, G	Cool, 4EC	48 hours
Oil & Grease	G	Cool, 4EC; H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Total Organic Carbon (TOC)	P, G	Cool, 4EC; HCl or H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Orthophosphate	P, G	Filter immediately; Cool, 4EC	48 hours
Oxygen, Dissolved-Probe	G Bottle & top	None required	Analyze immediately
Oxygen, Dissolved-Winkler	G Bottle & top	Fix on site and store in dark	8 hours
Phenols	G	Cool, 4EC; H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Phosphorus, Total	P, G	Cool, 4EC; H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Residue, Total	P, G	Cool, 4EC	7 days
Residue, Filterable (TDS)	P, G	Cool, 4EC	7 days
Residue, Nonfilterable (TSS)	P, G	Cool, 4EC	7 days
Residue, Settleable	P, G	Cool, 4EC	48 hours
Residue, Volatile (Ash Content)	P, G	Cool, 4EC	7 days
Silica	P	Cool, 4EC	28 days
Specific Conductance	P, G	Cool, 4EC	28 days
Sulfate	P, G	Cool, 4EC	28 days

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**ATTACHMENT B  
ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES,  
AND HOLDING TIMES  
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Parameter Number/Name	Container <sup>(1)</sup>	Preservation <sup>(2)(3)</sup>	Maximum Holding Time <sup>(4)</sup>
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**INORGANIC TESTS (Cont'd):**

Sulfide	P, G	Cool, 4EC; add zinc acetate plus sodium hydroxide to pH 9	7 days
Sulfite	P, G	None required	Analyze immediately
Turbidity	P, G	Cool, 4EC	48 hours

**METALS:<sup>(7)</sup>**

Chromium VI (Hexachrome)	P, G	Cool, 4EC	24 hours
Mercury (Hg)	P, G	HNO <sub>3</sub> to pH 2	28 days
Metals, except Chromium VI and Mercury	P, G	HNO <sub>3</sub> to pH 2	6 months

**ORGANIC TESTS:<sup>(8)</sup>**

Purgeable Halocarbons	G, Teflon-lined septum	Cool, 4EC; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup>	14 days
Purgeable Aromatic Hydrocarbons	G, Teflon-lined septum	Cool, 4EC; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup> HCl to pH 2 <sup>(9)</sup>	14 days
Acrolein and Acrylonitrile	G, Teflon-lined septum	Cool, 4EC; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup> adjust pH to 4-5 <sup>(10)</sup>	14 days
Phenols <sup>(11)</sup>	G, Teflon-lined cap	Cool, 4EC; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup>	7 days until extraction; 40 days after extraction
Benzidines <sup>(11), (12)</sup>	G, Teflon-lined cap	Cool, 4EC; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup>	7 days until extraction <sup>(13)</sup>
Phthalate esters <sup>(11)</sup>	G, Teflon-lined cap	Cool, 4EC	7 days until extraction; 40 days after extraction
Nitrosamines <sup>(11), (14)</sup>	G, Teflon-lined cap	Cool, 4EC; store in dark; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup>	7 days until extraction; 40 days after extraction
PCBs <sup>(11)</sup>	G, Teflon-lined cap	Cool, 4EC	7 days until extraction; 40 days after extraction
Nitroaromatics & Isophorone <sup>(11)</sup>	G, Teflon-lined cap	Cool, 4EC; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup> ; store in dark	7 days until extraction; 40 days after extraction
Polynuclear Aromatic Hydrocarbons (PAHs) <sup>(11), (14)</sup>	G, Teflon-lined cap	Cool, 4EC; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup> ; store in dark	7 days until extraction; 40 days after extraction
Haloethers <sup>(11)</sup>	G, Teflon-lined cap	Cool, 4EC; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup>	7 days until extraction; 40 days after extraction
Dioxin/Furan (TCDD/TCDF) <sup>(11)</sup>	G, Teflon-lined cap	Cool, 4EC; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup>	7 days until extraction; 40 days after extraction

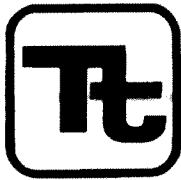


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**ATTACHMENT B  
ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES,  
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- (1) Polyethylene (P): generally 500 ml or Glass (G): generally 1L.
- (2) Sample preservation should be performed immediately upon sample collection. For composite chemical samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4EC until compositing and sample splitting is completed.
- (3) When any sample is to be shipped by common carrier or sent through the United States Mail, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172).
- (4) Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of samples under study are stable for the longer periods, and has received a variance from the Regional Administrator.
- (5) Should only be used in the presence of residual chlorine.
- (6) Maximum holding time is 24 hours when sulfide is present. Optionally, all samples may be tested with lead acetate paper before pH adjustments are made to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.
- (7) Samples should be filtered immediately on site before adding preservative for dissolved metals.
- (8) Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.
- (9) Sample receiving no pH adjustment must be analyzed within 7 days of sampling.
- (10) The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within 3 days of sampling.
- (11) When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity. When the analytes of concern fall within two or more chemical categories, the sample may be preserved by cooling to 4EC, reducing residual chlorine with 0.008% sodium thiosulfate, storing in the dark, and adjusting the pH to 6-9; samples preserved in this manner may be held for 7 days before extraction and for 40 days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (re: the requirement for thiosulfate reduction of residual chlorine) and footnotes 12, 13 (re: the analysis of benzidine).
- (12) If 1,2-diphenylhydrazine is likely to be present, adjust the pH of the sample to 4.0 $\pm$ 0.2 to prevent rearrangement to benzidine.
- (13) Extracts may be stored up to 7 days before analysis if storage is conducted under an inert (oxidant-free) atmosphere.
- (14) For the analysis of diphenylnitrosamine, add 0.008% Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> and adjust pH to 7-10 with NaOH within 24 hours of sampling.
- (15) The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.008% Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>.





**TETRA TECH**

# STANDARD OPERATING PROCEDURES

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Revision

4

Applicability

Tetra Tech, Inc.

Prepared

Earth Sciences Department

Subject

FIELD DOCUMENTATION

Approved

J. Zimmerly

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## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to identify and designate the field data record forms, logs, and reports generally initiated and maintained for documenting Tetra Tech NUS, Inc. (TtNUS) field activities.

## 2.0 SCOPE

Documents presented within this SOP (or equivalents) shall be used for all TtNUS field activities, as applicable. Other or additional documents may be required by specific client contracts or project planning documents.

## 3.0 GLOSSARY

None.

## 4.0 RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS

Project Manager (PM) - The PM is responsible for obtaining hardbound controlled-distribution logbooks (from the appropriate source), as needed. In addition, the Project Manager is responsible for placing all field documentation used in site activities (i.e., records, field reports, sample data sheets, field notebooks, and the site logbook) in the project's central file upon the completion of field work.

Field Operations Leader (FOL) - The FOL is responsible for ensuring that the site logbook, notebooks, and all appropriate and current forms and field reports included in this SOP (and any additional forms required by the contract) are correctly used, accurately filled out, and completed in the required time frame.

General personnel qualifications for field documentation activities include the following:

- Occupational Safety and Health Administration (OSHA) 40-hour and applicable refresher training.
- Capability of performing field work under the expected physical and environmental (i.e., weather) conditions.
- Familiarity with appropriate procedures for documentation, handling, packaging, and shipping.

## 5.0 PROCEDURES

### 5.1 SITE LOGBOOK

#### 5.1.1 General

The site logbook is a hard-bound, paginated, controlled-distribution record book in which all major on-site activities are documented. At a minimum, record or reference the following activities/events (daily) in the site logbook:

- All field personnel present
- Arrival/departure times and names of site visitors
- Times and dates of health and safety training
- Arrival/departure times of equipment
- Times and dates of equipment calibration

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- Start and/or completion of borehole, trench, monitoring well installation activities, etc.
- Daily on-site activities
- Sample pickup information
- Health and safety issues (level of protection, personal protective equipment [PPE], etc.)
- Weather conditions

Maintain a site logbook for each project and initiate it at the start of the first on-site activity (e.g., site visit or initial reconnaissance survey). Make entries every day that on-site activities take place involving TtNUS or subcontractor personnel. Upon completion of the fieldwork, provide the site logbook to the PM or designee for inclusion in the project's central file.

Record the following information on the cover of each site logbook:

- Project name
- TtNUS project number
- Sequential book number
- Start date
- End date

Information recorded daily in the site logbook need not be duplicated in other field notebooks (see Section 5.2) but must summarize the contents of these other notebooks and refer to specific page locations in these notebooks for detailed information (where applicable). An example of a typical site logbook entry is shown in Attachment A.

If measurements are made at any location, either record the measurements and equipment used in the site logbook or reference the field notebook in which the measurements are recorded (see Attachment A).

Make all logbook, notebook, and log sheet entries in indelible ink (black pen is preferred). No erasures are permitted. If an incorrect entry is made, cross out the entry with a single strike mark, initial, and date it. At the completion of entries by any individual, the logbook pages used must be signed and dated by the person making the entries. The site logbook must also be signed by the FOL at the end of each day.

### **5.1.2 Photographs**

Sequentially number movies, slides, or photographs taken of a site or any monitoring location to correspond to logbook/notebook entries. Enter the name of the photographer, date, time, site location, site description, and weather conditions in the logbook/notebook as the photographs are taken. A series entry may be used for rapid-sequence photographs. The photographer is not required to record the aperture settings and shutter speeds for photographs taken within the normal automatic exposure range. However, special lenses, films, filters, and other image-enhancement techniques must be noted in the logbook/notebook. If possible, such techniques shall be avoided because they can adversely affect the accuracy of photographs. Chain-of-custody procedures depend on the subject matter, type of camera (digital or film), and the processing it requires. Follow chain-of-custody procedures for film used for aerial photography, confidential information, or criminal investigation. After processed, consecutively number the slides of photographic prints and label them according to the logbook/notebook descriptions. Docket the site photographs and associated negatives and/or digitally saved images to compact disks into the project's central file.

## **5.2 FIELD NOTEBOOKS**

Key field team personnel may maintain a separate dedicated field notebook to document the pertinent field activities conducted directly under their supervision. For example, on large projects with multiple investigative sites and varying operating conditions, the Health and Safety Officer may elect to maintain a

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separate field notebook. Where several drill rigs are in operation simultaneously, each site geologist assigned to oversee a rig must maintain a field notebook.

### **5.3 FIELD FORMS**

All TtNUS field forms (see list in Section 6.0 of this SOP) can be found on the company's intranet site (<http://intranet.ttnus.com>) under Field Log Sheets. Forms may be altered or revised for project-specific needs, subject to client approval. Care must be taken to ensure that all essential information can be documented. Guidelines for completing these forms can be found in the related sampling SOPs.

#### **5.3.1 Sample Collection, Labeling, Shipment, Request for Analysis, and Field Test Results**

##### **5.3.1.1 Sample Log Sheet**

Sample log sheets are used to record specified types of data while sampling. The data recorded on these sheets are useful in describing the sample as well as pointing out any problems, difficulties, or irregularities encountered during sampling. Complete a sample log sheet for each sample obtained, including field quality control (QC) samples.

##### **5.3.1.2 Sample Label**

A typical sample label is illustrated in Attachment B. Complete the required information on the adhesive labels and apply them to every sample container. Obtain sample labels from the appropriate program/project source, request that they be electronically generated in house, or request them the laboratory subcontractor.

##### **5.3.1.3 Chain-of-Custody Record**

The chain-of-custody record is a multi-part form that is initiated as samples are acquired and accompanies a sample (or group of samples) as they are transferred from person to person. This form must be used as follows for any samples collected for chemical or geotechnical analysis whether the analyses are performed on site or off site:

- Retain one carbonless copy of the completed chain-of custody form in the field.
- Send one copy is sent to the PM (or designee)
- Send the original to the laboratory with the associated samples. Place the original (top, signed copy) of the chain-of custody form inside a large Ziploc<sup>®</sup>-type bag taped inside the lid of the shipping cooler. If multiple coolers are sent but are included on one chain-of custody form, send the form with the cooler containing vials for volatile organic compound (VOC) analysis or the cooler with the air bill attached. Indicate on the air bill how many coolers are included with that shipment.

An example of a chain-of-custody form is provided as Attachment C. After the samples are received at the laboratory, the sample cooler and contents are checked and any problems are noted on the enclosed chain-of custody form (any discrepancies between the sample labels and chain-of custody form and any other problems that are noted are resolved through communication between the laboratory point-of-contact and the TtNUS PM). The chain-of custody form is signed and copied. The laboratory will retain the copy, and the original becomes part of the samples' corresponding analytical data package.

##### **5.3.1.4 Chain-of-Custody Seal**

Attachment D is an example of a custody seal. The custody seal is an adhesive-backed label that is part of a chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field and sealed in coolers for transport to the laboratory. Sign and date custody seals

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and affix them across the lid and body of each cooler (front and back) containing environmental samples (see SOP SA-6.1). Obtain custody seals from the laboratory (if available) or purchase them from a supplier.

~~5.3.1.5~~ Geochemical Parameters Log Sheets

*Dr*  
2/17/12

~~Complete Field Analytical Log Sheets to record geochemical and/or natural attenuation field test results.~~

**5.3.2 Hydrogeological and Geotechnical Forms**

5.3.2.1 Groundwater Level Measurement Sheet

Complete a Groundwater Level Measurement Sheet for each round of water level measurements made at a site.

~~5.3.2.2~~ Data Sheet for Pumping Test

*Dr* 2/17/12

~~During the performance of a pumping test (or an in-situ hydraulic conductivity test), a large amount of data must be recorded, often within a short time period. Use a Pumping Test Data Sheet to facilitate this task by standardizing the data collection format for the pumping well and observation wells, and allowing the time interval for collection to be established in advance.~~

~~5.3.2.3~~ Packer Test Report Form

~~Complete a Packer Test Report Form for each well at which a packer test is conducted.~~

*Dr* 2/17/12

5.3.2.4 Boring Log

Complete a Summary Log of Boring, or Boring Log for each soil boring performed to document the materials encountered, operation and driving of casing, and locations/depths of samples collected. In addition, if volatile organics are monitored on cores, samples, cuttings from the borehole, or breathing zone, (using a photoionization detector [PID] or flame ionization detector [FID]), enter these readings on the boring log at the appropriate depth. When they become available, enter the laboratory sample number, concentrations of key contaminants, or other pertinent information in the "Remarks" column. This feature allows direct comparison of contaminant concentrations with soil characteristics.

5.3.2.5 Monitoring Well Construction Details Form

Complete a Monitoring Well Construction Details Form for every monitoring well, piezometer, or temporary well point installed. This form contains specific information on length and type of well riser pipe and screen, backfill, filter pack, annular seal and grout characteristics, and surface seal characteristics. This information is important in evaluating the performance of the monitoring well, particularly in areas where water levels show temporal variation or where there are multiple (immiscible) phases of contaminants. Depending on the type of monitoring well (in overburden or bedrock, stick-up or flush mount), different forms are used.

~~5.3.2.6~~ Test Pit Log

~~When a test pit or trench is constructed for investigative or sampling purposes, a Test Pit Log must be filled out by the responsible field geologist or sampling technician.~~

*Dr*  
2/17/12

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#### 5.3.2.7 Miscellaneous Monitoring Well Forms

Miscellaneous monitoring well forms that may be required on a project-specific basis include the Monitoring Well Materials Certificate of Conformance and Monitoring Well Development Record. Use a Monitoring Well Materials Certificate of Conformance to document all materials utilized during each monitoring well installation. Use a Monitoring Well Development Record to document all well development activities.

#### 5.3.2.8 Miscellaneous Field Forms – Quality Assurance and Checklists

Miscellaneous field forms/checklists forms that may be required on a project-specific basis include the following:

- Container Sample and Inspection Sheet – use this form when a container (drum, tank, etc.) is sampled and/or inspected.
- QA Sample Log Sheet – use this form when a QA sample such as an equipment rinsate blank, source blank, etc. is collected.
- Field Task Modification Request (FTMR) – use this form to document deviations from the project planning documents. The FOL is responsible for initiating the FTMRs. Maintain copies of all FTMRs with the on-site planning documents, and place originals in the final evidence file.
- Field Project Daily Activities Checklist and Field Project Pre-Mobilization Checklist – used these during both the planning and field effort to ensure that all necessary tasks are planned for and completed. These two forms are not requirements but are useful tools for most field work.

#### 5.3.3 **Equipment Calibration and Maintenance Form**

The calibration or standardization of monitoring, measuring, or test equipment is necessary to ensure the proper operation and response of the equipment, to document the accuracy, precision, or sensitivity of the measurements, and determine if correction should be applied to the readings. Some items of equipment require frequent calibration, others infrequent. Some are calibrated by the manufacturer, others by the user.

Each instrument requiring calibration has its own Equipment Calibration Log, which documents that the manufacturer's instructions were followed for calibration of the equipment, including frequency and type of standard or calibration device. Maintain an Equipment Calibration Log for each electronic measuring device used in the field; make entries for each day the equipment is used or in accordance with manufacturer recommendations.

### 5.4 **FIELD REPORTS**

The primary means of recording on-site activities is the site logbook. Other field notebooks may also be maintained. These logbooks and notebooks (and supporting forms) contain detailed information required for data interpretation or documentation but are not easily used for tracking and reporting of progress. Furthermore, the field logbook/notebooks remain on site for extended periods of time and are thus not accessible for timely review by project management. Other reports useful for tracking and reporting the progress of field activities are described below.

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#### **5.4.1 Daily Activities Report**

To provide timely oversight of on-site contractors, complete and submit Daily Activities Reports (DARs) as described below.

##### **5.4.1.1 Description**

The DAR documents the activities and progress for each day's field work. Complete this report on a daily basis whenever there are drilling, test pitting, well construction, or other related activities occurring that involve subcontractor personnel. These sheets summarize the work performed and form the basis of payment to subcontractors. The DAR form can be found on the TtNUS intranet site.

##### **5.4.1.2 Responsibilities**

It is the responsibility of the rig geologist to complete the DAR and obtain the driller's signature acknowledging that the times and quantities of material entered are correct.

##### **5.4.1.3 Submittal and Approval**

At the end of the shift, the rig geologist must submit the DAR to the FOL for review and filing. The Daily Activities Report is not a formal report and thus requires no further approval. The DARs are retained by the FOL for use in preparing the site logbook and in preparing weekly status reports for submission to the PM.

#### **5.4.2 Weekly Status Reports**

To facilitate timely review by project management, photocopies of logbook/notebook entries may be made for internal use.

In addition to those described herein, other summary reports may also be contractually required.

All TtNUS field forms can be found on the company's intranet site at <http://intranet.ttnus.com> under Field Log Sheets.

#### **6.0 LISTING OF FIELD FORMS ON THE TtNUS INTRANET SITE**

- Boring Log
- Container Sample and Inspection Sheet
- Daily Activities Checklist
- Daily Activities Record
- Equipment Calibration Log
- Field Task Modification Request
- Field Analytical Log sheet - Geochemical Parameters
- Groundwater Level Measurement Sheet
- Groundwater Sample Log Sheet
- Hydraulic Conductivity Test Data Sheet
- Low Flow Purge Data Sheet
- Bedrock Monitoring Well Construction (Stick Up)
- Bedrock Monitoring Well Construction Flush Mount
- Bedrock Monitoring Well Construction Open Hole
- Confining Layer Monitoring Well Construction
- Monitoring Well Development Record

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- Monitoring Well Materials Certificate of Conformance
- Overburden Monitoring Well Construction Flush Mount
- Overburden Monitoring Well Construction Stick Up
- Packer Test Report Form
- Pumping Test Data Sheet
- QA Sample Log Sheet
- Soil/Sediment Sample Log Sheet
- Surface Water Sample Log Sheet
- Test Pit Log
- Field Project Pre-Mobilization Checklist



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**ATTACHMENT A  
TYPICAL SITE LOGBOOK ENTRY**

START TIME: \_\_\_\_\_ DATE: \_\_\_\_\_

SITE LEADER: \_\_\_\_\_

PERSONNEL: \_\_\_\_\_

TINUS

DRILLER

SITE VISITORS

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

WEATHER: Clear, 68°F, 2-5 mph wind from SE


ACTIVITIES:

1. Steam jenny and fire hoses were set up.
2. Drilling activities at well \_\_\_\_ resumes. Rig geologist was \_\_\_\_\_. See Geologist's Notebook, No. 1, page 29-30, for details of drilling activity. Sample No. 123-21-S4 collected; see sample logbook, page 42. Drilling activities completed at 11:50 and a 4-inch stainless steel well installed. See Geologist's Notebook, No. 1, page 31, and well construction details for well \_\_\_\_\_.
3. Drilling rig No. 2 steam-cleaned at decontamination pit. Then set up at location of well \_\_\_\_\_.
4. Well \_\_\_\_\_ drilled. Rig geologist was \_\_\_\_\_. See Geologist's Notebook, No. 2, page \_\_\_\_ for details of drilling activities. Sample numbers 123-22-S1, 123-22-S2, and 123-22-S3 collected; see sample logbook, pages 43, 44, and 45.
5. Well \_\_\_\_\_ was developed. Seven 55-gallon drums were filled in the flushing stage. The well was then pumped using the pitcher pump for 1 hour. At the end of the hour, water pumped from well was "sand free."
6. EPA remedial project manager arrives on site at 14:25 hours.
7. Large dump truck arrives at 14:45 and is steam-cleaned. Backhoe and dump truck set up over test pit \_\_\_\_\_.
8. Test pit \_\_\_\_\_ dug with cuttings placed in dump truck. Rig geologist was \_\_\_\_\_. See Geologist's Notebook, No. 1, page 32, for details of test pit activities. Test pit subsequently filled. No samples taken for chemical analysis. Due to shallow groundwater table, filling in of test pit \_\_\_\_ resulted in a very soft and wet area. A mound was developed and the area roped off.
9. Express carrier picked up samples (see Sample Logbook, pages 42 through 45) at 17:50 hours. Site activities terminated at 18:22 hours. All personnel off site, gate locked.

\_\_\_\_\_  
Field Operations Leader

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**ATTACHMENT B  
SAMPLE LABEL**

 Tetra Tech NUS, Inc. 661 Andersen Drive Pittsburgh, 15220 (412)921-7090		Project:	
		Site:	
		Location:	
Sample No:		Matrix:	
Date:	Time:	Preserve:	
Analysis:			
Sampled by:		Laboratory:	

**ATTACHMENT C**  
**CHAIN-OF-CUSTODY RECORD FORM**



### CHAIN OF CUSTODY

NUMBER 3413

PAGE \_\_\_\_ OF \_\_\_\_

[illegible]

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE)

YELLOW (FIELD COPY)

PINK (FILE COPY)

4/02R  
FORM NO. TINUS-001

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**ATTACHMENT D  
CHAIN-OF-CUSTODY SEAL**

<b>Signature</b> <hr/>		<b>CUSTODY SEAL</b> <hr/>
<b>Date</b> <hr/>		<b>Signature</b> <hr/>



# STANDARD OPERATING PROCEDURES

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Effective Date	01/2012	Revision	7
Applicability	Tetra Tech, Inc.		
Prepared	Earth Sciences Department		
Subject	DECONTAMINATION OF FIELD EQUIPMENT		
Approved	J. Zimmerly		

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## 1.0 PURPOSE

Decontamination is the process of removing and/or neutralizing site contaminants that have contacted and/or accumulated on equipment. The purpose of this Standard Operating Procedure (SOP) is to protect site personnel, the general public, and the environment while preserving or maintaining sample integrity. It is further intended through this procedure to describe the steps necessary for proper decontamination of drilling equipment, earth-moving equipment, chemical sampling equipment and field operation and analytical equipment.

## 2.0 SCOPE AND APPLICABILITY

This procedure applies to all equipment used to provide access to/acquire environmental samples that may have become contaminated through direct contact with contaminated media including air, water, and soil. This equipment includes drilling and heavy equipment and chemical sampling and field analytical equipment. Where technologically and economically feasible, single-use sealed disposable equipment will be employed to minimize the potential for cross-contamination. This SOP also provides general reference information on the control of contaminated materials.

Decontamination methods and equipment requirements may differ from one project to another. General equipment items are specified in Section 6.0, but project-specific equipment must be obtained to address the project-specific decontamination procedures presented in Section 7.0 and applicable subsections.

## 3.0 GLOSSARY

Alconox/Liquinox - A brand of phosphate-free laboratory-grade detergent.

Decontamination Solution - A solution selected/identified in the Health and Safety Plan or Project-Specific Quality Assurance Plan. The solution is selected and employed as directed by the project chemist/health and safety professional.

Deionized Water (DI) - Tap water that has been treated by passing through a standard deionizing resin column. This water may also pass through additional filtering media to attain various levels of analyte-free status. The DI water should meet College of American Pathologists (CAP) and National Committee for Clinical Laboratory Standards (NCCLS) specifications for reagent-grade Type I water.

Potable Water - Tap water from any municipal water treatment system. Use of an untreated potable water supply is not an acceptable substitute for tap water.

Pressure Washing - Process employing a high-pressure pump and nozzle configuration to create a high-pressure spray of potable water. High-pressure spray is employed to remove solids from equipment.

Solvent – A liquid in which solid chemicals or other liquids are dissolved. The solvent of choice is pesticide-grade isopropanol. Use of other solvents (methanol, acetone, or hexane) may be required for particular projects or for a particular purpose (e.g., removal of concentrated waste) and must be justified in the project planning documents. For example, it may be necessary to use hexane when analyzing for trace levels of pesticides, PCBs, or fuels. In addition, because many of these solvents are not miscible in water, the equipment should be air dried prior to use. Solvents should not be used on PVC equipment or well construction materials.

Steam Pressure Washing - A cleaning method employing a high-pressure spray of heated potable water to remove various organic/inorganic chemicals from equipment.

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#### 4.0 RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS

Project Manager - Responsible for ensuring that all field activities are conducted in accordance with approved project plan(s) requirements.

Decontamination Personnel - Individuals assigned the task of decontamination. It is the responsibility of these individuals to understand the use and application of the decontamination process and solutions as well as the monitoring of that process to ensure that it is working properly. This is accomplished through visual evaluation, monitoring instrument scanning of decontaminated items, and/or through the collection of rinsate blanks to verify contaminant removal.

Field Operations Leader (FOL) - Responsible for the implementation of project-specific planning documents. This includes on-site verification that all field activities are performed in compliance with approved SOPs or as otherwise dictated by the approved project plan(s). The FOL is also responsible for the completion and accuracy of all field documentation.

Site Safety Officer (SSO) - Exercises shared responsibility with the FOL concerning decontamination effectiveness. All equipment arriving on site (as part of the equipment inspection), leaving the site, and moving between locations is required to go through a decontamination evaluation. This is accomplished through visual examination and/or instrument screening to determine the effectiveness of the decontamination process. Improper or incomplete decontamination is sufficient to restrict equipment from entering the site, exiting the site, or moving to a new location on the site until the objectives are successfully completed.

General personnel qualifications for decontamination activities include the following:

- Occupational Safety and Health Administration (OSHA) 40-hour and applicable refresher training.
- Capability of performing field work under the expected physical and environmental (i.e., weather) conditions.
- Familiarity with appropriate decontamination procedures.

#### 5.0 HEALTH AND SAFETY

In addition to the health and safety issues and reminders specified in subsections of this SOP, the following considerations and requirements must be observed as SOPs for field equipment decontamination activities:

- If any solvents or hazardous chemicals (e.g., isopropyl alcohol) are to be used in equipment decontamination activities, the FOL must first obtain the manufacturer's/supplier's Material Safety Data Sheet (MSDS) and assure that it is reviewed by all users (prior to its use), added to the site Hazardous Chemical Inventory, and maintained on site as part of the project Hazard Communication Program.
- Review and observe specific health and safety requirements (e.g., personal protective equipment [PPE]) specified in the project-specific health and safety plan for this activity.

#### 6.0 EQUIPMENT LIST

- Wood for decontamination pad construction, when applicable (see Section 7.1).

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- Tools for constructing decontamination pad frame, when applicable (see Section 7.1).
- Visqueen sheeting or comparable material to cover decontamination pad frame, when applicable (see Section 7.1).
- Wash/drying racks for auger flights and drill/drive rods, when applicable (see Section 7.2).
- PPE as specified in the project health and safety plan.
- Soap and water for washing and rinsing.
- Deionized water for final rinsing.
- Solvents (e.g., pesticide-grade isopropanol) for rinsing (see applicable portions of Section 7.2).
- Tubs, buckets, etc. for containerizing rinse water (see applicable portions of Section 7.2).
- Sample bottles for collecting rinsate blanks (see Section 7.2).
- Calibrated photoionization detector (PID) or flame ionization detector (FID) to monitor decontaminated equipment for organic vapors generated through the existence of residual contamination or the presence of decontamination solvent remaining after the piece was rinsed.
- Aluminum foil or clear clean plastic bag for covering cleaned equipment (see applicable portions of Section 7.2).
- Paper towels or cloths for wiping.
- Brushes, scrapers, or other hand tools useful for removing solid materials from equipment.
- Clear plastic wrap for covering or wrapping large decontaminated equipment items (see Section 7.2.2).
- Drum-moving equipment for moving filled waste drums (optional) (see Section 7.3).
- Drum labels for waste drums (see Attachment A).

## 7.0 PROCEDURES

The process of decontamination is accomplished through the removal of contaminants, neutralization of contaminants, or isolation of contaminants. To accomplish this activity, preparation is required including site preparation, equipment selection, and evaluation of the decontamination requirements and processes. Site contaminant types, concentrations, and media types are primary drivers in the selection of the types of decontamination and where it will be conducted. For purposes of this SOP, discussion is limited to decontamination procedures for general environmental investigations.

Decontamination processes will be performed at the location(s) specified in project-specific planning documents. Typical decontamination locations include the following:

- Temporary decontamination pads/facilities
- Sample locations
- Centralized decontamination pad/facilities



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- Combination of some or all of the above

The following discussion includes general considerations for the decontamination process. Specific construction and implementation procedures will be as specified in the project-specific planning documents and/or may be as dictated by site-specific conditions as long as the intent of the requirements in the planning documents is met. This intent is to contain any residual fluids and solids generated through the decontamination process.

## **7.1 Decontamination Pad Design/Construction Considerations**

### **7.1.1 Temporary Decontamination Pads**

Temporary decontamination pads may be constructed at satellite locations within the site area in support of temporary work areas. These structures are generally constructed to support the decontamination of heavy equipment such as drill rigs and earth-moving equipment but can be employed for smaller articles.

The purpose of the decontamination pad is to contain wash waters and potentially contaminated soil generated during decontamination procedures. Therefore, construction of these pads should take into account the following considerations:

- Site location – The decontamination site selected should be far enough from the work site to maximize decontamination effectiveness while minimizing travel distance. The location of the decontamination site shall be selected to provide, in the judgment of the FOL or FOL designee, compliance with as many of the following characteristics as practicable:
  - Well removed from pedestrian/vehicle thoroughfares.
  - Avoidance of areas where control/custody cannot be maintained.
  - Avoidance of areas where potential releases of contaminated media or decontamination fluids may be compounded through access to storm water transport systems, streams, or other potentially sensitive areas.
  - Avoidance of potentially contaminated areas.
  - Avoidance of areas too close to the ongoing operation, where cross-contamination may occur.

The selected decontamination site should include the following, where possible:

- Areas where potable water and electricity are provided.

#### **Safety Reminder**

When utilizing electrical power sources, either hard-wired or portable-generated sources, ensure that:

- All power is routed through a Ground Fault Circuit Interrupter (GFCI).
- All power cords are in good condition (no physical damage), rated for the intended energy load, and designated for outdoor use.

In situations where accomplishing these elements is not possible, it will be necessary to implement a site electrical grounding program.

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- Areas where support activities such as removing decontamination waters soil and sediment are possible without entering an active exclusion zone.
- Areas that offer sufficient size to carry out the specific decontamination sequence.
- Decontamination pad (decon pad) – The decon pad shall be constructed to meet the following characteristics:
  - Size – The size of the pad should be sufficient to accept the equipment to be decontaminated as well as permitting free movement around the equipment by the personnel conducting the decontamination. The size should permit these movements utilizing pressure/steam washer wands and hoses and minimizing splash due to work in close quarters.
  - Slope – An adequate slope will be constructed to permit the collection of water and potentially contaminated soil within a trough or sump constructed at one end. The collection point for wash waters should be of adequate distance that the decontamination workers do not have to walk through the wash waters while completing their tasks. Because the pad will be sloped, place a light coating of sand over the plastic to minimize potential slips and falls. See the text about liners below.
  - Sidewalls – The sidewalls shall be at least 6 inches in height (or as high as possible if 6 inches is not achievable) to provide adequate containment for wash waters and soil. If splash represents a potential problem, splash guards should be constructed to control overspray. Sidewalls may be constructed of wood, inflatables, sand bags, etc. to permit containment. Splash guards are typically wood frames with Visqueen coverings to control overspray.
  - Liner – Depending on the types of equipment and decontamination method to be used, the liner should be of sufficient thickness to provide a puncture-resistant barrier between the decontamination operation and the unprotected environment. Care should be taken to examine the surface area prior to placing the liner to remove sharp articles (sticks, stones, debris) that could puncture the liner. Liners are intended to form an impermeable barrier. The thickness may vary from a minimum recommended thickness of 10 mil to 30 mil. The desired thickness may be achieved through layering materials of lighter construction. It should be noted that various materials (rubber, polyethylene sheeting) become slippery when wet. To minimize this potential hazard associated with a sloped liner, a light coating of sand shall be applied to provide traction as necessary.
  - Wash/drying racks – Auger flights, drill/drive rods, and similar equipment require racks positioned off of the ground to permit these articles to be washed, drained, and dried while secured from falling during this process.

For decontamination of direct-push technology (DPT) equipment, the pad may be as simple as a mortar tub containing buckets of soapy water for washing and an empty bucket to capture rinse waters. Decontamination may be conducted at the rear of the rig to permit rapid tool exchange.

- Maintenance – Maintain the decontamination area by:
  - Periodically clearing the work area of standing water, soil, and debris, and coiling hoses to aid in eliminating slip, trip, and fall hazards. In addition, these articles will reduce potential backsplash and cross-contamination.

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- Regularly changing the decontamination fluids to ensure proper cleaning and prevent cross-contamination.
- PPE – Periodically evaluate the condition of, and maintain the decontamination equipment, including regular cleaning of face shields and safety glasses. This is critical to ensuring the safety of decontamination personnel and the integrity of the decontamination process, and it will ensure that equipment is functioning properly.

### **7.1.2 Decontamination Activities at Drill Rigs/DPT Units**

During subsurface sampling activities including drilling and DPT activities, decontamination of drive rods, Macro Core Samplers, split spoons, etc. is typically conducted at an area adjacent to the operation. Decontamination is generally accomplished using a soap/water wash and rinse utilizing buckets and brushes. This area requires sufficient preparation to accomplish the decontamination objectives.

Buckets shall be placed within mortar tubs or similar secondary containment tubs to prevent splash and spills from reaching unprotected environmental media. Drying racks shall be employed as directed for temporary pads to permit parts to dry and be evaluated prior to use/reuse. Methodology regarding this activity is provided in Section 7.2.

### **7.1.3 Decontamination Activities at Remote Sample Locations**

When sampling at remote locations, sampling equipment such as trowels and pumps/tubing should be evacuated of potentially contaminated media to the extent possible. This equipment should be wrapped in plastic for transport to the temporary/centralized decontamination location for final cleaning and disposition. Flushing and cleaning of single-use equipment such as disposable trowels, tubing, and surgeon's gloves may allow disposal of this equipment after visible soil and water remnants have been removed.

## **7.2 Equipment Decontamination Procedures**

The following represents procedures to be employed for the decontamination of equipment that may have contacted and/or accumulated contamination through site investigation activities.

### **7.2.1 Monitoring Well Sampling Equipment**

#### **7.2.1.1 Groundwater sampling equipment – This includes pumps inserted into monitoring wells such as bladder pumps, Whale pumps, and Redi-Flo pumps and reusable bailers, etc.**

1. Evacuate to the extent possible, any purge water within the pump/bailer.
2. Scrub using soap and water and/or steam clean the outside of the pump/bailer and, if applicable, the pump tubing.
3. Insert the pump and tubing/bailer into a clean container of soapy water. Pump/run a sufficient amount of soapy water through the pump/bailer to flush out any residual well water. After the pump is flushed, circulate soapy water through the pump to ensure that the internal components are thoroughly flushed.
4. Remove the pump and tubing/bailer from the container
5. Rinse external pump components using tap water.

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6. Insert the pump and tubing/bailer into a clean container of tap water. Pump/run a sufficient amount of tap water through the pump/bailer to evacuate all of the soapy water (until clear).

**CAUTION**

Do not rinse PE, PVC, and associated tubing with solvents –  
Use the procedures defined in the project-specific planning documents. If they are not defined, contact the FOL for guidance. The solvent rinse described in Step 7 may be omitted if groundwater does not contain oil, grease, PAHs, PCBs, or other hard to remove organic materials.

7. If groundwater contains or is suspected to contain oil, grease, PAHs, PCBs, or other hard to remove organic materials, rinse the equipment to be cleaned with pesticide-grade isopropanol.
8. Pass deionized water through the hose to flush out the tap water and solvent residue as applicable.
9. Drain residual deionized water to the extent possible.
10. Allow components of the equipment to air dry.
11. For bladder pumps, disassemble the pump and wash the internal components with soap and water, then rinse with tap water, isopropanol, and deionized water and allow to dry. After the parts are dry, conduct a visual inspection and a monitoring instrument scan to ensure that potential contaminants and all decontamination solvent have been removed. Collect a rinsate blank in accordance with the project-specific planning documents to ensure that the decontamination process is functioning as intended. The typical frequency of collection for rinsate blanks is 1 per 20 field samples. In addition, wipe samples or field tests such as UV light may be used.
12. Wrap pump/bailer in aluminum foil or a clear clean plastic bag for storage.

**SAFETY REMINDER**

Remember when handling powered equipment to disconnect the power source and render the equipment to a zero energy state (both potential and kinetic) before opening valves, disconnecting lines, etc.

#### 7.2.1.2 Electronic Water Level Indicators/Sounders/Tapes

During water level measurements, rinsing the extracted tape and probe with deionized water and wiping the surface of the extracted tape between locations is acceptable. However, periodic full decontamination should be conducted as follows:

1. Wash with soap and water
2. Rinse with tap water
3. Rinse with deionized water

**NOTE**

In situations where oil, grease, free product, other hard to remove materials are encountered, probes and exposed tapes should be washed in hot soapy water. If probes or tapes cannot be satisfactorily decontaminated (they are still stained, discolored, etc.), they should be removed from service.

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### 7.2.1.3 Miscellaneous Equipment

Miscellaneous equipment including analytical equipment (water quality testing equipment) shall be cleaned per manufacturers' instructions. This generally includes wiping the sensor housing and rinsing with tap and deionized water.

Coolers/shipping containers employed to ship samples are received from the laboratory in a variety of conditions including marginal to extremely poor. Coolers shall be evaluated prior to use for the following:

- Structural integrity – Coolers missing handles or having breaks in the outer housing should be removed and not used. Notify the laboratory that the risk of shipping samples in the cooler(s) provided is too great and request a replacement unit.
- Cleanliness – As per protocol, only volatile organic samples are accompanied by a trip blank. If a cooler's cleanliness is in question (visibly dirty/stained) or if there are noticeable odors, the cooler should be decontaminated prior to use as follows:
  1. Wash with soap and water
  2. Rinse with tap water
  3. Dry

If these measures fail to clean the cooler to an acceptable level, remove the unit from use as a shipping container and ask the cooler provider (e.g., the analytical laboratory) to provide a replacement unit.

### 7.2.2 **Downhole Drilling Equipment**

This includes any portion of the drill rig that is over the borehole, including auger flights, drill stems, rods, and associated tooling that would extend over the borehole. The following procedure is to be employed prior to initiating the drilling/sampling activity, then between locations:

#### **CAUTION**

Exercise care when using scrapers to remove soil and debris from downhole drilling equipment. Inadvertent slips of scrapers have resulted in cuts, scrapes, and injured knuckles, so use scrapers carefully when removing soil from these items.

1. Remove loose soil using shovels, scrapers, etc.
2. Through a combination of scrubbing using soap and water and/or steam cleaning or pressure washing, remove visible dirt/soil from the equipment being decontaminated.

#### **CAUTION**

In Step 3, do not rinse PE, PVC, and associated tubing with solvents. The appropriate procedures should be defined within the project-specific planning documents. If they are not defined, contact the FOL for guidance. The solvent rinse described in Step 4 may be omitted if groundwater does not contain oil, grease, PAHs, PCBs, or other hard to remove organic materials.

3. Rinse the equipment with tap water, where applicable (steam cleaning and pressure washing incorporate rinsing as part of the process).

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4. If the equipment has directly or indirectly contacted contaminated sample media and is known or suspected of being contaminated with oil, grease, PAHs, PCBs, or other hard to remove organic materials, rinse equipment with pesticide-grade isopropanol
5. To the extent possible, allow components to air dry.
6. If the decontaminated equipment is to be used immediately after decontamination, screen it with a calibrated photoionization detector (PID)/flame ionization detector (FID) to ensure that all contaminants and possible decontamination solvents (if they were used) have been adequately removed.
7. Wrap or cover equipment in clear plastic until it is time to be used.

***SAFETY REMINDER***

Even when equipment is disconnected from power sources, dangers such as the following may persist:

Falls - An auger flight standing on its end may fall and injure someone. Secure all loose articles to prevent heavy articles from falling onto people or equipment.

Burns - Steam cleaner water is heated to more than 212 °F and exhibits thermal energy that can cause burns. Prevent contact of skin with hot water or surfaces.

High water pressure - Pressure washer discharge can have 2,000 to 4,000 psi of water pressure. Water under this amount of pressure can rupture skin and other human tissues. Water at 4,000 psi exiting a 0° tip can be dangerous because of its relatively high cutting power. The exit velocity and cutting power of the water are reduced when exiting a 40° fan tip, but damage to soft tissues is still possible.

In general, follow the rules below to avoid injury, equipment damage, or incomplete decontamination:

1. Read the operating manual and follow the manufacturers' recommended safety practices before operating pressure washers and steam cleaners.
2. Never point the pressure washer or steam cleaner at another person or use to clean your boots or other parts of your body. Water lacerations and burns may appear to be minor at first but can be life threatening. Do not attempt to hold small parts in your hand while washing them with high-temperature or high-pressure water.
3. Always wear PPE as specified in the HASP such as:
  - Hard hat, safety glasses, splash shield, impermeable apron or splash suit, and hearing protection. Remember that excessive noise is a hazard when operating gas-powered engines and electrically driven pressure washers. PPE will be identified in your project specific planning documents.
4. Inspect each device before use. An inspection checklist will be provided in the project-specific planning documents. If it is a rented device, safety measures are typically provided by the vendor. In all cases, if you are not familiar with the operation of a pressure washer/steam cleaner, do not operate it until you obtain and thoroughly review operating instructions and recommended safety practices.
5. Do not modify equipment unless the manufacturer has approved the modifications.

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### 7.2.3 Soil/Sediment Sampling Equipment

This section applies to soil sampling equipment including but not limited to hand augers, stainless steel trowels/spoons, bowls, dredges, scoops, split spoons, Macro Core samplers, etc.

1. Remove all loose soil from the equipment through manual means.
2. Through a combination of scrubbing using soap and water and/or steam cleaning or pressure washing, remove visible dirt/soil from the equipment.
3. Rinse the equipment with tap water.

#### **CAUTION**

Do not rinse PE, PVC, and associated tubing with solvents. The appropriate procedures should be defined within the project-specific planning documents. If they are not defined, contact the FOL for guidance. The solvent rinse described in Step 4 may be omitted if groundwater does not contain oil, grease, PAHs, PCBs, or other hard to remove organic materials.

4. If the equipment is contaminated or suspected to be contaminated with oil, grease, PAHs, PCBs, or other hard to remove organic materials, rinse the equipment with pesticide-grade isopropanol.
5. Rinse the equipment with deionized water.
6. To the extent possible, allow components to air dry.
7. If the equipment is to be used immediately after decontamination, screen it with a calibrated PID/FID to ensure that all solvents (if they were used) and trace contaminants have been adequately removed.
8. After the equipment has dried, wrap it in aluminum foil for storage until use.

Dredges employed in sediment sampling are typically decontaminated as follows:

- Remove the sediment sample from the sampling device
- If sufficient associated surface water is available at the sampling site, place the dredge in the water and flush to remove visible sediment.
- Extract the dredge and wash it in soap and water per the project-specific planning documents.

#### **CAUTION**

When handling dredges, the primary safety concern is trapping fingers or extremities in the larger dredge samplers within the jaws or pinch points of the mechanical jaws. Keep hands, fingers, and extremities away from these pinch and compression points. Either handle the device by the rope or preferably lock the jaws in place to control the potential for closing during maintenance and/or cleaning.

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### 7.3 **Contact Waste/Materials**

During the course of field investigations, disposable/single-use equipment becomes contaminated. These items include tubing, trowels, PPE (gloves, overboots, splash suits, etc.), and broken sample containers.

With the exception of the broken glass, single-use articles should be cleaned (washed and rinsed) of visible materials and disposed as normal refuse. The exception to this rule is that extremely soiled materials that cannot be cleaned shall be containerized for disposal in accordance with applicable federal, state, and local regulations.

#### 7.3.1 **Investigation-Derived Wastes - Decontamination Wash Waters and Sediments**

##### **NOTE**

Requirements for waste storage may differ from one facility to the next. Facility-specific directions for waste storage areas will be provided in project-specific documents, or separate direction will be provided by the Project Manager.

1. Assume that all investigation-derived waste (IDW) generated from decontamination activities contains the hazardous chemicals associated with the site unless there are analytical or other data to the contrary. Waste solution volumes could vary from a few gallons to several hundred gallons in cases where large equipment required cleaning.
2. Where possible, use filtering systems to extend the use of water within a closed system wash unit to recycle water and to reduce possible waste amounts.

##### **NOTE**

Containerized waste rinse solutions are best stored in 55-gallon drums (or equivalent containers) that can be sealed until ultimate disposal at an approved facility.

3. Label waste storage containers appropriately labeled (see Attachment A).
4. Ensure that the IDW storage area is configured to meet the following specifications to permit access to the containers and to conduct spill/leak monitoring, sampling, and extraction when the disposal route is determined:
  - Enclose areas accessible by the general public using construction fencing and signs.
  - Stored materials in 55-gallon drums on pallets with four (or fewer) drums per pallet.
  - Maintain the retaining bolt and label on the outside of storage containers where readily visible.
  - Provide at least 4 feet of room between each row of pallets to allow access to containers for sampling, drum removal, and spill response.
  - As directed in project-specific planning documents, maintain an IDW Inventory List and provide the list to the site Point of Contact at the termination of each shift.
  - Maintain spill response equipment at the IDW storage area in case it is required for immediate access.



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- Where possible, use equipment for moving containers. Where not possible, obtain help to manipulate containers.

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**CAUTION**

Each container of water can weigh up to 490 pounds. Each 55-gallon drum of wet soil can weigh more than 750 pounds. Fill drums and temporary containers to 80 percent capacity to minimize spill and handling difficulties. Use drum carts to move filled drums.

See safe lifting techniques provided in Section 4.4 of the Tetra Tech NUS, Inc. Health and Safety Guidance Manual.

When placing drums, keep your fingers out of pinch and smash points such as between the drums. In some cases such as well development and/or purge water, you can place the drums to be filled on the pallet and transport materials in smaller easier to handle containers.

#### 7.4 **Decontamination Evaluation**

Upon decontamination of equipment, determine the effectiveness of the decontamination process in the following manner:

- Visual evaluation – A visual evaluation will be conducted to ensure the removal of particulate matter. This shall be done to ensure that the washing/rinsing process is working as intended.
- Instrument Screening – A properly calibrated PID/FID should be used to evaluate the presence of site contaminants and solvents used in the cleaning process. The air intake of the instrument shall be passed over the article to be evaluated. Avoid placing the instrument probe into residual waters. A PID/FID reading greater than the daily established background level requires a repeat of the decontamination process, followed by rescreening with the PID/FID. This sequence must be repeated until no instrument readings greater than the daily established background level are observed. It should be noted that the instrument scan is only viable if the contaminants are detectable within the instrument's capabilities.

**NOTE**

When required by project-specific planning documents, collection of rinsate blanks (see next step) shall be completed without exception unless approval to not collect these samples is obtained from the Project Manager.

- Collection of Rinsate Blanks – It is recommended that rinsate samples be collected to:
  - Evaluate the decontamination procedure representing different equipment applications (pumps versus drilling equipment) and different decontamination applications.
  - Single-use disposable equipment – The number of samples should represent different types of equipment as well as different lot numbers of single-use articles.
  - The collection and the frequency of collection of rinsate samples are as follows unless specified differently in the project-specific planning documents:
    - Per decontamination method
    - Per disposable article/batch number of disposable articles

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***NOTE***

It is recommended that an initial rinsate sample be collected early in the project to ensure that the decontamination process is functioning properly and to avoid using a contaminated batch of single-use articles. It is recommended that a follow-up sample be collected later during the execution of the project to ensure that those conditions do not change.

Rinsate samples collection may be driven by types of and/or levels of contaminant. Difficult to remove contaminants, oils/greases, some PAHs/PCBs, etc. may also support the collection of additional rinsates due to the obvious challenges to the decontamination process. This is a field consideration to be determined by the FOL.



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Applicability

Tetra Tech, Inc.

Prepared

Earth Sciences Department

Subject

DECONTAMINATION OF FIELD EQUIPMENT

Approved

J. Zimmerly

## Attachment A iDW Label

**INVESTIGATION DERIVED WASTE**

GENERATOR INFORMATION:

SITE \_\_\_\_\_ JOB NO. \_\_\_\_\_

LOCATION \_\_\_\_\_

DATE \_\_\_\_\_

DRUM# \_\_\_\_\_

CONTENTS \_\_\_\_\_

VOLUME \_\_\_\_\_

CONTACT \_\_\_\_\_

EMERGENCY PHONE NUMBER \_\_\_\_\_

## 6.9 Ground Water Sampling Procedures

[◀ Return to TOC](#)

### 6.9.1 Scope

These procedures describe recommended methods as well as minimally acceptable methods for obtaining representative ground water samples for organic, inorganic, residue, nutrient, bacteriological and other general chemical analyses. Ground water monitor wells, homeowners' private supply wells, and industrial or municipal supply wells are the potential sources of these samples. Temporary well points and ground water collected via direct push technology represent additional sources. The procedures described herein are to be followed by Department personnel, state-approved contract vendors, contractor personnel or anyone submitting ground water data to the NJDEP. Samples obtained in a way that does not meet these minimum criteria will not be considered as representative ground water samples and will not be accepted. In the case of state-approved vendors, unrepresentative sample collection may form the basis of non-payment for services rendered.

All ground water monitoring wells shall be constructed in accordance with current NJDEP specifications found in the, *Subsurface and Percolating Waters Act*, N.J.S.A. 58:4A-4.1 et seq., their implementing regulations (N.J.A.C. 7:9D-1.1 et seq.) and any NJDEP approved changes to these specifications including repeals, new rules and amendments. The Department's Bureau of Water Allocation administers the above Act and oversees all related licensing and permitting activities. Any deviations to the well construction or well decommissioning standards must be approved by the Bureau of Water Allocation prior to the initiation of said activities. Monitor well specifications for Bedrock Formations, Unconsolidated Formations, and Confined Formations are provided in Appendix 6.1 of this section. General guidance on the construction of temporary wells installed via direct push technology can be referenced through this manual, ASTM D6001-96 *Direct Push Water Sampling for Geoenvironmental Investigations*, and via the following Internet links: <http://www.epa.gov/superfund/programs/dfa/dirtech.htm>, <http://epa.gov/swrust1/pubs/esa-ch5.pdf>, <http://geoprobe.com>, and <http://www.ams-samplers.com/main.shtm?PageName=welcome.shtm>.

Before any intrusion into the subsurface can begin, consideration for underground utilities must be taken. To accomplish this, the New Jersey One Call underground utility markout service must be contacted at 1-800-272-1000. They must be provided the following information: Name of caller, title, phone number, fax number, best time to call back, contractor name, contractor address, name of facility/company work is being done for, their phone number and address, the dig location, municipality, street address, nearest intersection, type of work, extent of work, start and end date. More information can be obtained by going to their website at: <http://www.nj1-call.org>. The local municipality, in which the work is being conducted, must also be notified in order to identify and mark out any ancillary underground utilities falling under their jurisdiction.

Additional regulations that must be complied with prior to collection of ground water samples and respective data submission to the Department include the 'Technical Requirements for Site Remediation', N.J.A.C. 7:26E and Laboratory Certification N.J.A.C. 7:18. Respectively, these regulations require: 1) purge and sample water derived from a well be monitored for pH, dissolved oxygen, temperature and specific conductance (7:26E-3.13(c) 7i., ii., iii. & iv.); 2) before **ANY** field analysis of those water quality parameters classified as "analyze immediately," those firms using LFPS instrumentation must first be certified by the Office of Quality Assurance (N.J.A.C. 7:18).

Finally, it is the policy of the Department of Environmental Protection that a sampling plan be submitted for approval before the initiation of ANY low-flow purging and sampling event.

### 6.9.2 Means of Sample Collection

The equipment and means utilized for specific ground water sample collection can vary greatly depending on the following factors:

- Type of well (e.g., monitor well, supply well, temporary well point)
- Depth of well
- Diameter of well casing
- Depth to water
- Contaminants likely to be encountered
- Analytes of interest
- Length of open borehole (bedrock well)
- Slot size of screen, screen type and length of screen
- Zones of infiltration
- Expected recharge rate of well
- Sampling objectives (field screening, remedial investigation, quarterly sampling, No Further Action [NFA] closeout, Monitored Natural Attenuation sampling, or filtered samples)

Based on the above considerations, the options chosen to evacuate ground water and collect a sample can generally fall into one of the five categories:

- Temporary well point/Direct Push - Ground water purged and sampled *without regard\** to monitoring “stabilization.”
- Low-flow purging and sampling (LFPS) - Ground water purged and sampled **within** the screened/borehole interval *with regard* to monitoring “stabilization”
- Low-Yield, Low-flow purging and sampling - Ground water purged and sampled **within** the screened/borehole interval in a well displaying uncontrollable drawdown necessitating sample collection *without regard\** to monitoring “stabilization”
- Volume-averaged sample - Ground water purged and sampled **above** the well screen *without regard\** to monitoring “stabilization”
- Point source grab sample - Ground water obtained as a grab sample from **within** the screened interval *without regard\** to monitoring stabilization.

Refined further, below are the types of equipment associated with each of the five general categories:

- Temporary well point /Direct Push
  - \* Bailer<sup>b</sup>
  - \* Bladder pump<sup>c</sup>
  - \* Inertial pump<sup>c</sup>
  - \* Peristaltic pump<sup>d</sup>
- LFPS in the screened/borehole interval utilizing a **variable-speed**, positive-displacement pump including:
  - \* Bladder pump<sup>f</sup>
  - \* Gear pump<sup>f</sup>
  - \* Reciprocating piston pump<sup>f</sup>

- ] Progressive cavity pump<sup>f</sup>
  - ] Submersible centrifugal pump<sup>f</sup>
- Low-yield LFPS in the screened/borehole interval of a well displaying uncontrollable drawdown utilizing a **variable-speed**, positive-displacement pump including:
  - ] Bladder pump<sup>g</sup>
  - ] Gear pump<sup>g</sup>
  - ] Progressive cavity pump<sup>g</sup>
  - ] Reciprocating piston pump<sup>g</sup>
  - ] Submersible centrifugal pump<sup>g</sup>
- Volume-averaged sample
  - ◇ Pump intake positioned immediately above the well screen at a depth of less than 25 feet utilizing a **variable-speed**, suction-lift or positive-displacement pump including:
    - ] Bailer<sup>b</sup>
    - ] Bladder pump<sup>e</sup>
    - ] Gear pump<sup>e</sup>
    - ] Peristaltic pump<sup>d</sup>
    - ] Progressive cavity pump<sup>e</sup>
    - ] Reciprocating piston pump<sup>e</sup>
    - ] Submersible centrifugal pump<sup>e</sup>
    - ] Surface centrifugal pump<sup>a</sup>
  - ◇ Pump intake positioned immediately above the well screen at a depth greater than 25 feet utilizing a **variable-speed**, positive-displacement pump including:
    - ] Bladder pump<sup>e</sup>
    - ] Gear pump<sup>e</sup>
    - ] Progressive cavity pump<sup>e</sup>
    - ] Reciprocating piston pump<sup>e</sup>
    - ] Submersible centrifugal pump<sup>e</sup>
  - ◇ Pump intake positioned at the top of the water column at a depth of less than 25 feet utilizing a **variable-speed**, suction-lift or positive-displacement pump including:
    - ] Bladder pump<sup>e</sup>
    - ] Gear pump<sup>e</sup>
    - ] Peristaltic pump<sup>d</sup>
    - ] Progressive cavity pump<sup>e</sup>
    - ] Reciprocating piston pump<sup>e</sup>
    - ] Submersible centrifugal pump<sup>e</sup>
    - ] Surface centrifugal pump<sup>a</sup>
  - ◇ Pump intake positioned at the top of the water column at a depth greater than 25 feet utilizing a **variable-speed**, positive-displacement pump including:
    - ] Bladder pump<sup>e</sup>
    - ] Gear pump<sup>e</sup>
    - ] Reciprocating piston pump<sup>e</sup>
    - ] Submersible centrifugal pump<sup>e</sup>
    - ] Progressive cavity pump<sup>e</sup>
- Point source grab sample
  - ] Passive diffusion bag sampler<sup>h</sup>

\* Gore Sorber<sup>i</sup>

\* Syringe sampler<sup>j</sup>

<sup>a</sup>purge only

<sup>b</sup>sample from top of water column only

<sup>c</sup>purge and sample for volatile organics only, limited to field screening

<sup>d</sup>purging acceptable for all contaminants however, sampling restricted to metals, Pesticides and PCBs

<sup>e</sup>purge and sample for all contaminants

<sup>f</sup>purge and sample for all contaminants including water quality indicators

<sup>g</sup>purge and sample for all contaminants based upon sufficient sample volume within the well to operate pump and fill all sample containers.

<sup>h</sup>sample for select volatiles only

<sup>i</sup>sample for select contaminants in coordination with manufacturer's analysis, limited to field screening

<sup>j</sup>sample for volatiles only, limited to field screening

*\*without regard* – This category of sampling technique is not conducive to accurate measurement of WQIP for determining stabilization. If collecting samples for programs regulated by Technical Requirements for Site Remediation, a variance from the requirement to provide pH, dissolved oxygen, specific conductance and temperature (N.J.A.C. 7:26E-3.13(c)7i.,ii.,iii. & iv.) must first be attained before sampling can commence.

The order in which analytical samples should be collected is as follows:

1. Volatile organic compounds (VOCs)
2. Purgeable organic compounds (POC)
3. Purgeable organic halogens (POX)
4. Total organic halogens (TOX)
5. Total organic carbon (TOC)
6. Base neutrals/acid extractables
7. TPHC/Oil & Grease
8. PCBs/pesticides
9. Total metals
10. Dissolved metals
11. Phenols
12. Cyanide
13. Sulfate and chloride
14. Turbidity
15. Nitrate and ammonia
16. Preserved inorganics
17. Radionuclides
18. Non-preserved inorganics
19. Bacteria

When several wells will be sampled of known or suspected contamination, the least contaminated well should be sampled first, and the wells then sampled in order of increasing contaminant



concentrations. Monitoring wellhead vapor readings with photo- or flame- ionization detectors can aid in determining sample order by providing information on contaminant levels in the wells. Attention to decontamination procedures must be strictly followed.

Surgical gloves must be changed between each sample location. Clean sampling equipment and any other objects entering the well should not be allowed to contact the ground or any other potentially contaminated surfaces (i.e. gasoline-fueled generators). If this should occur, that item should not be placed in the well or utilized for sampling.

For specific information on sampling procedures with a particular pump or other piece of sampling equipment refer to Chapter 5.

#### 6.9.2.1 Temporary Well Points and Direct Push Technology

The Alternative Ground Water Sampling Techniques (AGWST) Guide is now incorporated herein. Use of the techniques listed in the 1994 version, with the exception of the screened auger (Method AGWST 1.00), remain viable alternatives to sampling ground water when “field screening” is the sampling objective. Issues of contaminant carryover downhole using Method AGWST 1.00 have rendered this alternative unacceptable. In addition, other sampling methods are available (e.g., narrow-diameter “mini” bailers) for sampling the miniature drive point. (Method AGWST2.00), therefore, sampling them with peristaltic pumps is no longer acceptable unless specifically approved on a case-by-case basis. Access to the complete guide can be attained using the following URL: <http://www.state.nj.us/dep/srp/regs/agws>. When referring to the 1994 AGWST Guide, all construction, decontamination, purging and sampling techniques must follow this or subsequent editions of the *Field Sampling Procedures Manual* in effect. The phrase “temporary well” is used here figuratively to consolidate the five acceptable techniques described in the AGWST Guide. They include use of a Miniature Drive Point, a Well Point, a Passively Place Narrow Diameter Point, a Direct Push Point, and use of a HydroPunch® sampler. Other commercially available devices, which have similar design and function capabilities, may be deemed acceptable for use with prior approval.

Temporary wells are typically, narrow-diameter wells, with short screens, installed by hand (shallow), drill rig, or hydraulic direct push. If the casing/screen are removed and the borehole is properly decommissioned within 48 hours of their installation, they are considered to be Category 5 Geotechnical Wells, pursuant to N.J.A.C. 7:9D-2.1(a)5. Any well remaining in the ground for more than 48 hours will be classified as a permanent well and thus will be subject to all the regulations regarding monitor well construction and decommissioning found in the “Subsurface and Percolating Water Act”, N.J.S.A. 58:4A-4.1 et seq., and their implementing regulations (N.J.A.C. 7:9D-1.1 et seq.).

Temporary wells may be used for both horizontal and vertical delineation of contamination under certain circumstances; (e.g., if the sampling method does not impact sample quality and vertical profiling using direct push methods does not cause cross-contamination of samples during advancement in the same borehole). Determination of whether temporary well points may be used for delineation is made on a case-by-case basis by the SRP case team.

Direct push samplers typically cause turbid samples since there is no filter pack and the formation interval of interest is not fully developed. As such, analytical results for total metals may be biased high. Application of samplers designed with pre-attached filter packs offers a means to reduce turbidity, however, there is no guarantee turbidity will be completely eliminated. Generally, since volatile organic contaminant concentrations are not typically influenced by the presence of suspended material, the VOC values derived from this technique provide reliable field-screening data.

Temporary well points and direct push samplers typically have short screens. Therefore, the sampler will focus on a narrow zone in the aquifer. Examples of the use of temporary well points are those used to characterize a groundwater contaminant plume through vertical profiling using screening-level data. They can also be used to construct “transects” whereby temporary well points are placed at selected intervals perpendicular to the direction of plume movement. This focused approach allows for refined decision making when placing permanent monitor wells and plume delineation. In addition, advancement in direct push technology now allows for the generation of extended geophysical and hydrogeological data once strictly associated with monitor well installation and observation.

The American Society for Testing Materials discusses general technique issues in ASTM D6001-96, *Direct Push Water Sampling for Geoenvironmental Investigations*. Additional information can be found on the Internet at the following USEPA and vendor URLs:

<http://www.epa.gov/superfund/programs/dfa/dirtech.htm>,

<http://www.epa.gov/swerust1/pubs/esa-ch5.pdf>

[http://www.geoprobe.com/products/tools/tools\\_menu.htm](http://www.geoprobe.com/products/tools/tools_menu.htm), and

<http://www.geoinsightonline.com>

<http://www.ams-samplers.com/main.shtm?PageName=welcome.shtm>

#### 6.9.2.2 Low-Flow Purging and Sampling

##### 6.9.2.2.1 Method Summary and Application

The purpose of Low-Flow Purging and Sampling (LFPS) is to collect groundwater samples from monitor wells that are representative of ambient groundwater conditions in the aquifer. This is accomplished by setting the intake velocity of the sampling pump to a flow rate that limits drawdown inside the well. LFPS has three primary benefits. First, it minimizes disturbance of sediment in the bottom of the well, thereby producing a sample with low turbidity. Second, LFPS minimizes aeration of the groundwater during sample collection. Third, the amount of groundwater purged from a well is usually reduced as compared to conventional groundwater purging and sampling methods.

Because the method allows collection of groundwater samples with low turbidity, it was originally used for collecting samples for inorganics analysis. The method typically allows the collection of samples for total metals analysis and eliminates the need to filter the samples for dissolved metals analysis. In addition, since the method minimizes aeration of the samples, it can be used to collect samples for analysis of volatile and semi-volatile organic compounds (VOCs and SVOCs), provided that appropriate pumps are used in sample collection, as discussed below.

Advantages of LFPS are:

- Groundwater samples tend to be more representative of actual aquifer conditions with respect to mobile contaminants and turbidity
- It causes minimal disturbance of the formation adjacent to the screened interval
- It is generally less prone to sampling variability compared to other groundwater sampling techniques (e.g., bailers)
- Smaller purge volumes and associated disposal expense

- Increased sample consistency from dedicated systems and reproducibility of data due to reduced operator variability

Disadvantages of LFPS are:

- Misconceptions regarding reduced purging and sampling time
- Sampling from non-dedicated systems requires greater set-up time
- Sampling from dedicated systems requires higher initial capital expenses
- Increased technical complexity
- Increased training needs for sampling personnel
- Attractiveness of advantages may lead to improper and inconsistent application
- Typically not a “first round” sampling option
- Not recommended for wells with long screen intervals unless multiple samples are collected

### 6.9.2.2.2 Introduction

The following procedures are specific to LFPS of monitor wells in New Jersey. These procedures were developed in consideration of the USEPA-Region I guidance document dated July 30, 1996 (<http://www.epa.gov/region01/measure/well/lowflow8.pdf>) and the USEPA-Region II guidance document dated March 16, 1998 (<http://www.epa.gov/Region2/desa/hsw/lowflow.txt>). In addition, the U.S. Geological Survey's (USGS) Techniques of Water-Resources Investigations, Book 9, National Field Manual for the Collection of Water-Quality Data was consulted (<http://water.usgs.gov/owq/FieldManual/>). The reader is encouraged to review these guidance documents prior to performing LFPS. The procedures provided in the USEPA and USGS guidance must be followed except where they differ from the information provided below. Finally, three forms are provided herein to assist the sampler in recording low-flow stabilization data, calibration information and pump intake depth placement. They can be found on pages 109, 110, and 111 respectively.

### 6.9.2.2.3 Low Flow Policy

In the event that a responsible party is conducting a Remedial Investigation without Departmental oversight, submittal of a sampling plan is not required. However, it is *highly recommended* that the responsible party seek approval for any deviations from this guidance prior to conducting LFPS. In the event that a responsible party decides to use LFPS without submitting a sampling plan and receiving approval, it must be recognized that any deviations from this guidance may result in rejection of the data. In addition, when submitting the results of the LFPS event, the responsible party must include specific details of the LFPS techniques used which demonstrate that they were consistent with the guidance specified below. The responsible party shall also provide adequate rationale justifying any deviations from this guidance whether or not they were previously approved by the Department.

It is also Departmental policy that LFPS is not an acceptable method for any wells with screened or open borehole intervals greater than 5 feet in length **unless:** 1) multiple locations at five-foot intervals along the screen/borehole are sampled, or 2) the data quality objectives (DQOs) warrant sampling a specific zone (e.g., the shallow water table to investigate the potential for vapor intrusion inside a building) or

specific zones where sufficient geophysical (e.g., heat-pulse flowmeter, caliper and temperature logs, etc.) and hydrogeological information (e.g., tracer tests) or other evidence (e.g., stained soils or fractures noted on boring logs) that **clearly** identifies the depth(s) at which contaminants are entering the well screen or open borehole.

Once the collection of multiple samples (vertical profiling) in a well has been completed, long-term sampling of the well may require LFPS at fewer depth intervals, or even just one depth interval, depending on the data quality objectives of the sampling and the types of contamination present in the groundwater (e.g., LNAPL, DNAPL, etc.).

#### 6.9.2.2.4 Laboratory Certification (N.J.A.C. 7:18)

N.J.A.C. 7:18 requires that any environmental laboratory\* submitting analytical data to the Department, regardless of quality level, must be certified by the Office of Quality Assurance. This applies to those firms using LFPS instruments associated with the “analyze immediately” category of water quality indicator parameters (WQIPs) including pH, temperature, and dissolved oxygen. Regardless of whether or not the equipment in question is rented or privately owned the requirement for certification can not be ignored. All certification documentation must accompany the instrument into the field and accompany all WQIP data submitted to the Department. (\*Environmental laboratory is defined as any laboratory, facility, consulting firm, government or private agency, business entity or other person that the Department has authorized, pursuant to N.J.A.C. 7:18, to perform analysis in accordance with the procedures of a given analytical method using a particular technique as set forth in a certain methods reference document and to report the results from the analysis of environmental samples in compliance with a Departmental regulatory program).

#### 6.9.2.2.5 Specific LFPS Considerations

##### 6.9.2.2.5.1 Pump Intake Location

When LFPS is performed correctly, the data being collected should be a snapshot of a narrow zone along a length of well screen or fracture in an open borehole. For these reasons, it is important to place the pump intake in the zone of highest contaminant concentration or contaminant flux along the screened/open-hole interval. This is particularly important in wells constructed with more than 5 feet of well screen.

Information to be considered when selecting the pump intake depth should include: 1) evidence of soil/sediment contamination from boring logs; 2) soil/sediment sampling analytical results; 3) vertical profiles of groundwater and soil contamination developed from direct-push sampling and field-screening techniques; and; 4) lithology/stratigraphy, particularly the permeability of the aquifer materials.

Typically, the most permeable zones are selected for the pump intake location since the majority of contaminant mass will be transported through them, particularly as the plume migrates downgradient of the source area. Identification of these zones may be made from borehole geophysical data, (e.g., resistivity, fluid conductance, or natural gamma logging, etc.) and hydraulic conductivity data or grain-size analyses. The use of a series of passive-diffusion-bag samplers in a well may also help to identify the zone of highest VOC contamination. The physical/chemical behavior of the contaminants of concern should be considered when determining

the pump intake depth. For example, gasoline-related contaminants may be present near the water table while chlorinated VOCs may be present deeper in the aquifer. If a well is contaminated by both types of contaminants, both may need to be sampled, each from a discrete sampling interval.

As discussed above, LFPS is not an option in wells with screened intervals that exceed 5 feet in length, **unless** multiple sample locations at five-foot intervals along the screen/borehole are investigated. Monitor wells screened across zones of significant geologic heterogeneity or open boreholes in fractured rock may be subject to significant vertical flow. Under those conditions, use of packers to isolate specific zones should be considered.

#### 6.9.2.2.5.2 Water Quality Indicator Parameters (WQIPs)

For groundwater investigations in New Jersey utilizing LFPS, the following parameters must be measured in order to determine when well stability has been achieved prior to sampling. Their respective measurements must fall within the stated range for three consecutive readings. If the anticipated “third” reading of any individual parameter does not fall within the stated range, then the process to achieve three consecutive readings for that parameter must be restarted. If, after four hours, stability has not been achieved for the parameters listed below, follow the recommendations in Section 3 below.

Water Level Drawdown .....	< 0.3 ft*
pH .....	± 0.1 unit
Specific Conductance .....	± 3%
Temperature .....	± 3%
Dissolved Oxygen .....	± 10%
Turbidity .....	± 10% for values greater than 1 NTU
ORP/Eh .....	± 10 millivolts

\* During pump start-up, drawdown may exceed the 0.3-ft target and then recover as flow-rate adjustments are made.

In wells with short screens (i.e., 5 to 10 ft long) or when sampling for gasoline constituents at the water table, it is much more important to limit the drawdown to less than 0.3 ft, for example, than a well with 15 ft of screen being sampled for metals only with the pump intake set in a permeable zone 5 ft or more below the water table. When sampling groundwater for VOCs and SVOCs, aerating the water by allowing it to cascade down the inside of the well should be avoided. Therefore, drawdown should not expose the screen more than 0.3 ft below the static water level in the well.

Measurements should be taken once every 5 to 6 minutes. This interval is based upon the time it takes for purge water to replace one flow-through-cell volume (generally 250 ml) and the time it takes to measure and record the data. If the purge rate decreases or if the flow cell volume is increased, the time required for purge water replacement will increase. Forms at the end of this document should be used to record drawdown and the WQIPs.

WQIP measurements must be collected in a manner that will insure integrity of the data being collected. To insure consistency of the data, consideration of the following must be made: 1) tubing diameter, length, and material of construction;



2) flow-through cell design, capacity, decontamination, and “purge-train” set-up; 3) pump selection and plumbing fittings; 4) calibration of flow-through cell probes; 5) purge rate; and, 6) water-level-measurement technique.

#### 6.9.2.2.5.3 Purge Volume vs. Stabilization Time

In some cases, it may take considerable time to achieve stabilization of the WQIPs. In other cases, they may never stabilize. However, as provided in USEPA guidance, the following options are available if stability has not been achieved after **FOUR** hours of purging: 1) continue purging until stabilization occurs, no matter how long it takes; 2) discontinue purging, do not collect a sample and document the attempts to reach stabilization; or 3) discontinue purging, collect a sample and document the attempts to reach stabilization. In situations where WQIPs do not stabilize, the sampler must document that LFPS could not be performed and document in the report how the samples were collected.

While every effort should be taken to assure that all of the WQIPs stabilize prior to sample collection, one should keep in mind that the stabilization of some WQIPs may be more difficult to achieve than others. Also, achieving stabilization of some WQIPs may be more important with respect to some contaminant types (e.g., metals versus VOCs, etc.) than others. For example, total metals concentrations tend to increase with increasing turbidity due to sorption of metals on solids in the water. Similarly, VOC concentrations may be affected by dissolved oxygen (DO) concentrations (i.e., whether the groundwater is aerobic or anaerobic). In addition to providing information on the effectiveness of LFPS, collection of accurate DO data also aids in the evaluation of monitored natural attenuation (MNA) of VOC plumes. Similarly, temperature data can provide useful information regarding the sampling method. For example, temperature increases resulting from dissipation of heat generated by the submersible pump or from exposure of the tubing to excessive heat at the ground surface can have a significant impact on VOC concentrations in water samples.

If, for whatever reason, a WQIP is not accurately measured during the monitoring process or a certain WQIP does not stabilize, and that particular WQIP is **not** significant with respect to the type of contaminant of concern, sample collection may still proceed. For example, if DO data do not stabilize but all of the other WQIPs including drawdown and turbidity stabilize and samples will be collected for metals only, then the samples may be collected. However, any WQIPs that are affected by field conditions or instrument malfunction, must be discussed in the text of the report in order to alert the end-user of potential data bias. If questions arise regarding when stabilization occurs, the sampler should contact the Department’s assigned case manager for the site, if any, either prior to (preferably) or when performing LFPS.

#### 6.9.2.2.5.4 Tubing

The inside diameter (ID) of tubing should be no greater than three-eighths of an inch (3/8-in). Quarter-inch (1/4-in) tubing is preferred. Larger tubing diameters reduce flow velocity resulting in a corresponding increase of pump speeds to maintain flow. Increased pump speed will, in turn, elevate the potential for turbulent flow across the screened interval and this may affect the quality of the water being sampled. Conversely, any reduction in flow velocity may allow air to become

trapped in the tubing, which may ultimately affect air-sensitive parameters or allow particulates to settle, which may affect turbidity values.

The length of tubing, from the top of the well casing to the flow-through chamber, should be the shortest length manageable. Attention to this detail will help ensure that: 1) exposure to ambient temperature, direct sunlight, and bubble formation are kept to a minimum, and 2) deposited solids or air bubbles will less likely be trapped in tubing bends and re-mobilized after accidental movement. Occurrence of any one or combination of these factors can cause variations in WQIP measurements, which could increase stabilization time. Therefore, tubing must be completely full of water at all times.

If the sampling plan calls for multiple sample locations within the well screen, sampling should proceed from the top location to the bottom location. This will require that additional tubing be coiled at the surface to allow for pump relocation to the next deeper sampling location. In these instances, the coiled tubing must be protected from ambient conditions and the ground surface, in order to avoid impact to the WQIPs and sample data.

The tubing's material of construction must be either Teflon® or Teflon®-lined polyethylene up to the flow-through cell. This is consistent with collection of any groundwater sample. Tubing downstream of the flow cell may be constructed of a lower-quality, more flexible material. However, when sampling for metals analysis only, the tubing may be constructed of flexible polypropylene or polyethylene.

Tubing “reuse” is not recommended when sampling well to well since decontamination of tubing is difficult and time consuming. If tubing is to be reused, it must undergo a rigorous decontamination procedure, which must include a hot water wash/hot air drying process. In addition to the hot water wash/hot air drying, separate decontamination solutions of acetone and nitric acid may have to be pumped through the tubing for 15 minutes, followed by copious amounts of distilled, deionized water rinses. The cost of labor associated with decontamination, including the special handling of cleaning solvents and acid, often exceeds the cost of simply discarding the old tubing and using new tubing for each well. If a decision is made to reuse tubing, then one of the following requirements in the USGS, *Water-Quality National Field Manual*, must be considered: 1) Collect additional field blanks if VOC concentrations in the last sample collected through the tubing are greater than 500 µg/L, or 2) The tubing should be replaced, rather than cleaned, if VOC concentrations in the last sample exceed 700 µg/L.

#### 6.9.2.2.5.5 Flow-Through Cell

Typical flow-through cell design is not complicated and almost all on the market today have common shared features. Cells should be transparent in order to “see” the physical condition of the purge water or air bubbles passing through the system. Highly turbid or iron bacteria-laden water can be visually monitored for change as the purge progresses. The cell must be sealed against unwanted exposure to the atmosphere, thus insuring accurate measurement of air-sensitive parameters (dissolved oxygen, pH, etc.). The total capacity of the cell must be small (300-1,000 ml) in order to maintain a desirable turnover rate of water coming into the cell to ensure real-time data integrity. The in-line design must allow for purge

water to enter the flow cell from a bottom port and exit at the top. The discharge may be fitted with a check valve.

Upon initial pump startup, it is good practice to not connect the pump discharge line to the flow-through cell. This will allow the sampler time to monitor draw-down, stabilize the flow rate and prevent fouling of probes by bacteria, sediment, or NAPL. Once drawdown measurements indicate that the flow rate has been controlled and a few minutes (<10) have been allowed to clear any unwanted material, the pump discharge line can then be connected to the flow cell.

Flow cell decontamination is important, not only to reduce the potential for cross contamination, but also to ensure data integrity and consistent instrument performance. The cell and probes should be rinsed with distilled/deionized water between each monitor well as accumulation of suspended material may impact probe performance. If they are exposed to contaminants, use a mild detergent or laboratory glassware cleaning solution. Flow cell exposure to high levels of contamination may damage probes and require their repair by the manufacturer. Since LFPS is NOT normally a first-round sampling option, knowledge of contaminant levels will generally be known prior to the cell's exposure to purge water.

The location of the flow cell or cells in relation to the sample port is critical. Samples for turbidity measurement, general chemistry and laboratory analysis must be collected ahead of the flow cell. When two cells are used in series, the dissolved oxygen probe must be located in the first cell.

Set up the flow-through cell in a location which will cause minimal fluctuation of the flow rate due to elevation changes in the sample tubing as the tubing is disconnected from the cell prior to sample collection. It is also important to locate the flow-through cell as close as possible to the well head in order to minimize the length of tubing needed between the well head and flow-through cell. The flow-through cell must be protected from ambient conditions and the ground surface. See Figure 6.6.

#### 6.9.2.2.5.6 Pump Selection

Pumps used for monitoring WQIPs must be submersible, positive-displacement pumps. Examples of acceptable positive-displacement pumps include bladder, variable-speed submersible-centrifugal, reciprocating-piston, progressive-cavity, and gear pumps. The pump discharge must be fitted appropriately to receive either 1/4 or 3/8-inch inside-diameter (ID) Teflon® or Teflon®-lined polyethylene tubing.

Peristaltic pumps are suction-lift pumps, which can create a negative pressure gradient. Therefore, their use is not appropriate when collecting groundwater samples for analysis of organic compounds. However, peristaltic pumps may be used for the collection of groundwater samples for analysis of inorganic compounds. It should be kept in mind, however, that sampling with peristaltic pumps may affect the stabilization of some WQIPs including dissolved oxygen, pH and redox potential. Since these WQIPs can be affected by the peristaltic pump, this pump should not be used when these data are to be used to evaluate the effectiveness of Monitored Natural Attenuation of groundwater.



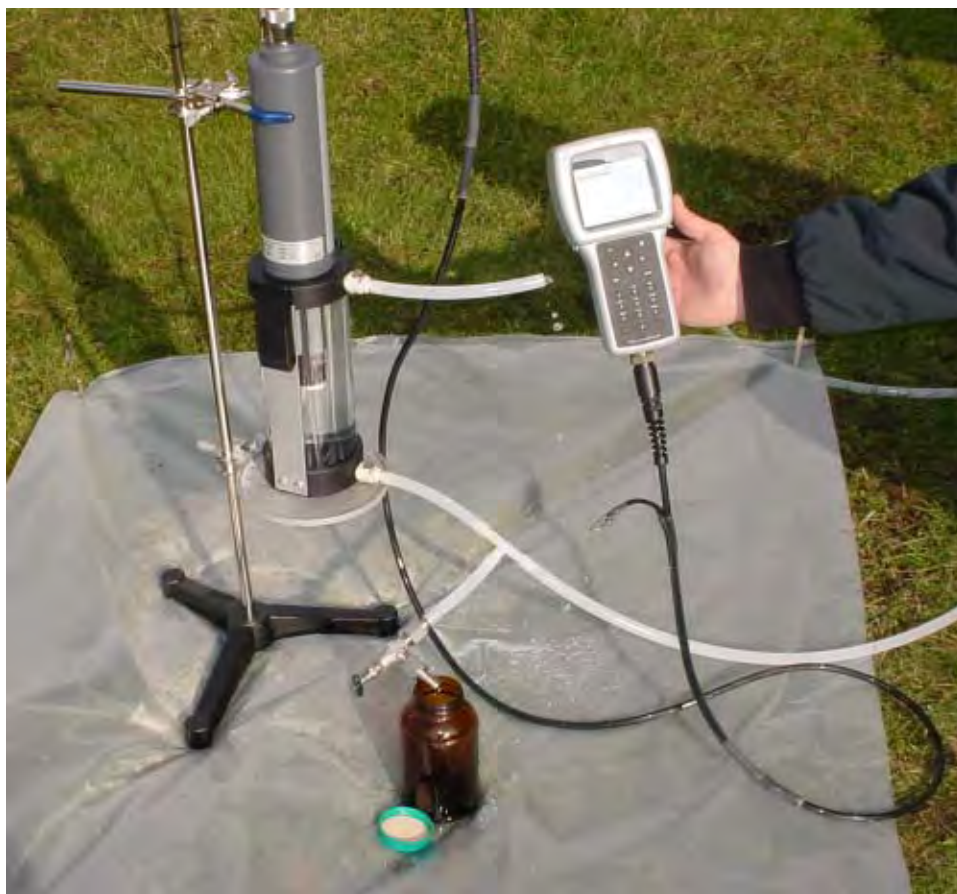


Figure 6.6 Illustration of Flow Cell with stand. (Photograph by J. Schoenleber)

Two basic collection scenarios have a bearing on pump selection. These include: 1) a permanently installed pump system, or 2) a portable (well-to-well) pump installation. Bladder pumps can be used for either scenario, however, only those with disposable bladders and easily cleaned parts are suitable when sampling on a well-to-well basis. Variable-speed submersible-centrifugal pumps, gear or progressive-cavity pumps can be used for either scenario as long as they are constructed of easy to clean stainless steel/Teflon® parts.

Pumps constructed with impellers, helicoils, or gears, which are difficult to clean or are constructed of unacceptable plastic parts, are not suitable for sampling. In addition, when conducting LFPS on a portable basis, the power or gas supply line should be isolated from the sample tubing. Power supply and sample tubing lines that form a single unit do not allow for easy decontamination and are not recommended.

#### 6.9.2.2.5.7 Plumbing Fittings

A check valve should be incorporated into the tubing train or flow cell discharge to eliminate accidental drainage and subsequent aeration of the flow cell. More importantly, a check valve will prevent a back-surge of purged water being reintroduced at the screen interval of the well should the power source or pump experience mechanical failure. A back-surge of purge water into the screened interval of the well may result in variability of the WQIPs and create analytical bias. In order to avoid the need to decontaminate the check valve, it may be placed on the discharge side of the flow cell or installed immediately above the pump discharge. Some flow-through cells have check valves built into the unit. By design, bladder pumps also have a check valve built into their construction.

A ¼- or 3/8-inch ID barbed “T” or “Y” fitting, placed ahead of the flow cell, may be used to establish the line which will receive a needle valve for turbidity, general

chemistry and analytical sample collection. The “T” or “Y” fitting used should be constructed of Teflon® or stainless steel and decontaminated between each use, if used for analytical samples. The fitting may be constructed of polyethylene and decontaminated between each use if it is only used to sample for turbidity and general chemistry parameters. If analytical samples are collected through the “T” or “Y” fitting and needle valve, then those parts must be incorporated into the field blank collection technique.

When collecting a sample at the port ahead of the flow cell, a flow control valve (stainless-steel needle valve [preferred] or stainless steel/Teflon ball valve [optional]) must be used to prevent backpressure and air bubbles from forming in the tubing (see [http://water.usgs.gov/owq/FieldManual/chap4\\_rpt.pdf](http://water.usgs.gov/owq/FieldManual/chap4_rpt.pdf), page 84). The “needle valve” offers versatility as it can be used for collection of turbidity, general chemistry **and** analytical samples. It can be used with Teflon® tubing and can be used to control sample flow rate because the design significantly reduces any backpressure gradient. Like all other sampling equipment, the “needle valve” must be decontaminated before use at any well. See Figure 6.7.



Figure 6.7 Closeup of Needle Valve.  
(Photograph by D. Dibblee)

#### 6.9.2.2.5.8 Calibration of Probes

Calibration of the probes used to monitor water quality indicator parameters must take place **in the field prior** to the day's events. The Office of Quality Assurance must certify the *environmental laboratory* (see Section 6.9.2.2.4) using probes for pH, dissolved oxygen and temperature measurement.

There are no exceptions to these rules. Probe calibration is critical to the accurate and precise measurement of WQIPs.

For warranty purposes, **all** manufacturers' instructions for proper care and calibration must be followed. Solutions for probe calibration must be held to the temperature of the liquid (groundwater) being measured as temperature correlation is critical in calculating conductivity, dissolved oxygen and pH. Tables and equations to compensate for the difference between ambient groundwater and calibration solution temperature are sometimes provided in the operating manuals or with the calibration solutions. Some instruments are designed with internal features to

compensate for this difference in temperature. The respective difference between calibration of conductivity and specific conductivity requires compensation for groundwater temperature at the time of calibration vs. solution temperature adjusted to 25°C at the time of calibration. For dissolved oxygen, the flow cell itself must be maintained at the temperature of groundwater during calibration. All efforts made to account for proper temperature control of solutions during calibration must be reported to the end user. All steps must be recorded in the field notes. No sampling shall commence until all instruments are calibrated and operating properly. See the “Tips” section below for further discussion on Temperature of Calibration Solutions.

#### 6.9.2.2.5.9 Water Level Measurements

The depth to the top of the water column must be recorded prior to pump installation and/or prior to purging. If the **total** depth of the well needs to be determined (e.g., to verify the correct well designation and/or to determine if silt has accumulated in the bottom of a well), it should be measured at least 48 hours prior to sample collection or after the sample has been collected and the pump removed. Total depth measurements must never be taken immediately before purging as this may cause the re-suspension of solids in the well and prolong the purge time.

Once the initial water-level measurement has been recorded and the pump installed, suspend the water-level probe in the well at the point at which drawdown is equivalent to a 0.3-foot drop. Record water levels simultaneously with WQIP measurements once every five minutes.

Water-level-measurement devices, which may impart some disturbance to the water column (i.e., stainless steel “popper” or coated tape), are not acceptable.

#### 6.9.2.2.5.10 Pump Installation

LFPS pump installation can be divided into two general collection scenarios: permanent and portable (well to well). Permanent pump installation is the most desirable. Among other advantages are improved consistency in data acquisition and reduced long-term labor, preparation and material costs. However, permanent installation is more typically associated with long-term monitoring due to the high initial capital investment required.

The more common practice is to use a pump on a portable or well-to-well basis. While initial capital investment is comparatively less than that of a permanent installation, this practice requires close attention to quality control aspects of pump selection, preparation and decontamination.

Once pumps have been properly decontaminated and fitted with appropriate tubing, installation of the pump can begin. Ideally, pumps should be installed 24 to 48 hours prior to initiation of purging. However, this is not always practical, especially when site security can not be guaranteed. In addition, wells constructed with flush-mount casing are difficult to protect from storm water or infiltration of other contaminants during the extended period monitor wells are open.

Pumps must be installed in such a manner as to insure any disturbance in the well is kept to an absolute minimum. Once pumps reach the top of the water column, their descent should proceed very slowly through the water column. The actual

level where the pump intake is to be suspended must be predetermined. Under no circumstance should the pump make contact with, or be “bounced” off, the bottom of the well.

One helpful method to insure proper intake location is to accurately measure and pre-cut the tubing for each individual well prior to site activity. A mark can be made on the tubing, which coincides, with the top of the well. Cutting the tubing off-site in a controlled setting is most desirable. Tubing can be wiped down with paper towels, moistened with distilled/ deionized water, labeled and then sealed into plastic bags until needed. If this practice is used, be sure to allow enough tubing to account for the distance from the top of the well casing to the flow cell.

#### 6.9.2.2.5.11 Purge Rates

Control over the purge rate is one of the most critical aspects of this technique. Once the pump is set within the screened interval at the desired location, a clean electronic water-level-monitoring device is lowered approximately 0.3 ft into the water column. Start the pump at a speed that results in a flow rate in the range of 100 to 500 ml/min. Pump the initial purge water to waste in order to prevent any fouling of the flow-through cell. *With the pump running*, connect the tubing to the cell. Make sure that all air is purged from the tubing and flow cell as the system fills with purge water. For LFPS, the pump speed must remain constant such that flow rates never exceed 500 ml/min and, once stabilized, the flow rate must not be varied, even during sample collection. If drawdown continues to exceed 0.3 ft., reduce the pump speed until the drawdown has stabilized but do not adjust pump speed to a flow rate below 100 ml/min. Flow rates below this level may induce pump stalling and undo the effort to reach stabilization. If drawdown does not come under control at 100 ml/min, then a field decision should be rendered as to how far to allow drawdown to continue until sample collection. At no time should evacuation allow any portion of the well screen to be exposed (for wells screened below the water table) or bring the well to dryness.

Adjustments to pump speed are best made during the first 15 minutes. Once a “feel” for the purge rate is obtained, begin recording well stabilization indicators. Any significant change to purge rates after this time may negatively impact well stabilization measurements.

Purge rates are best monitored by measuring the flow from the discharge side of the flow cell with a graduated cylinder. Record all of the required WQIPs once every 5 minutes. Once stability has been attained and recorded, begin sample collection

#### 6.9.2.2.5.12 Sampling

Once WQIPs have stabilized, or a 4-hour time decision has been rendered, sampling can proceed. Do not adjust the flow rate; maintain the same pumping rate during sampling that was used to purge the well. Collect the sample directly from the needle valve at the sample port. The needle valve allows for sample collection with significantly reduced backpressure and turbulence and offers the best means for sample collection without affecting water quality. It also allows for monitoring using the flow-through cell during sample collection, thereby allowing a final WQIP measurement to be recorded immediately after sample collection. This is the



preferred method, especially if volatile organic compounds are the parameters of concern. Any exceptions to this technique must first be approved in writing from the NJDEP on a case-by-case basis before commencing sampling operations.

If higher than expected water temperatures are being observed, evaluate whether the submersible pump is overheating. If the pump motor is not suspected, check the system for any exposure to direct sunlight, especially during warmer periods of the year.

#### 6.9.2.2.5.13 Pump Decontamination

The pump forms one of the two key elements of sampling equipment (tubing is the other). The importance of proper pump decontamination is especially true when pumps are rented and utilized on a well-to-well basis. Never assume that rented pumps have been thoroughly cleaned. **Pumps constructed with plastic parts, or sealed inner workings that are inaccessible to direct handling are not an option for LFPS well-to-well consideration because of their limited ability to be decontaminated thoroughly.**

Most bladder pumps can not be easily decontaminated in the field due to their unique construction. For that reason, bladder pumps are not employed on a well-to-well basis **unless** they are constructed with easy to clean parts and *disposable* bladders. Bladder pumps are best suited for dedicated (permanently installed) scenarios. Another popular pump, the variable-speed, 2-inch diameter submersible, is more adaptable for well-to-well sampling; however, close attention to decontamination is warranted. One manufacturer, Grundfos®, clearly states in the operational handbook that the pump must be completely disassembled, including removal of the motor shaft from the stator housing, and all components within the impeller housing (See Figure 6.8). Care must be taken upon reassembly to insure that the cavity housing the motor shaft is *completely* refilled with distilled/deionized water. Care must also be taken with this pump during periods of cold weather to avoid freezing of the coolant water. Proper decontamination not only helps to ensure more reliable data; it also prolongs the life of any pump.

#### 6.9.2.2.5.14 Field Blank Collection

When employing LFPS techniques, collection of the field blank must follow the same general rules for all groundwater sampling equipment. This includes the requirement that “all” sampling equipment, which comes in contact with the sample, must also come into contact with the field blank water. To overcome some of the difficulties that manual field blank collection through the inside of a pumping system creates, the following procedure is strongly recommended. Fill a 1000-ml decontaminated, graduated glass cylinder with method blank water supplied by the laboratory performing the analysis. Place a properly decontaminated pump into the graduated cylinder with sample tubing and plumbing fittings attached. Activate the pump and collect the required field blank samples. As the water is removed from the cylinder, replace it with additional method blank water. This procedure will require that the laboratory supply larger volumes of field blank water i.e., bulk water in liter or 4-liter containers. The traditional requirement that field blank water be supplied in the same identical containers as the sample being collected can not be practically satisfied when using LFSP. The identical bottle-to-bottle field blank requirement is waived for this sampling technique procedure only.



Figure 6.8 Grundfos® Pump being prepared for decontamination (Photograph by J. Schoenleber)

#### 6.9.2.2.6 Tips

##### 6.9.2.2.6.1 Temperature Measurement and Submersible Pumps

Variable-speed submersible pumps such as the Grundfos Redi Flo 2<sup>â</sup> pump use water to cool the motor during operation. Sometimes, reduced flow rates may result in insufficient cooling of the motor and may elevate the temperature of the water to a point where it may begin to affect sample integrity. If the pump is used in low-yielding, two (2)- or four (4)- inch-diameter wells, temperature increases that do not stabilize may result. If this is observed, a field decision must be made to either discontinue or continue with LFPS. If all other WQIPs have stabilized, then collecting the sample and qualifying the water-quality data accordingly may be acceptable. If the temperature increase continues and eventually exceeds 40% of the initial recorded temperature (Celsius) and other WQIPs have not stabilized, sampling should be discontinued. Turning the pump off and on to control overheating is not acceptable. Always keep in mind that elevated temperature has a direct relationship with dissolved oxygen, specific conductance and, to a lesser degree, pH measurement. Higher temperatures may also reduce the concentrations of volatile organic compounds in groundwater samples due to their relatively high Henry's Law constants. If sampling with submersible pumps continues to result in elevated water temperature, other sampling alternatives should be discussed with the appropriate regulatory program.

When using some submersible pumps in large-diameter wells (six inch and greater), overheating of the motor, followed by mechanical shutdown and possible motor damage, may occur. This is the result of water being drawn to the pump intake in a more horizontal flow pattern which diminishes the design feature that

normally moves cool water vertically across the motor (stator) housing. The use of specially designed shrouds may overcome this condition.

#### 6.9.2.2.6.2 Control of Pump Speed

In order to achieve the high turning speeds, low-speed startup torque is generally lacking in some submersible pumps including the Grundfos<sup>®</sup> Redi Flo 2 pump. When attempting to control initial drawdown and/or sample flow rates, it is possible for the pump to cease pumping. Then, if a check valve has been installed, the pump may not have enough torque to overcome the head pressure when attempting to restart it. Sometimes, turning the pump to the highest speeds will overcome this situation or sometimes the pump may have to be pulled from the well and reinstalled. Neither of these corrective measures is conducive to LFPS. To avoid this scenario, make sure the control box comes equipped with a “ten turn pot” frequency adjustment knob. This will allow significantly greater control over pump speeds and the risk of losing pump flow will be reduced.

#### 6.9.2.2.6.3 pH

Monitoring for stabilization of pH in groundwater is relatively straightforward and rarely requires serious troubleshooting. When calibrating for pH, do a two-point calibration, at a minimum. The calibration range should bracket the anticipated pH. If the pH is unknown, then a three-point calibration must be made. The temperature of the buffer solutions should be as close to the temperature of the groundwater as possible. If the probe does not calibrate properly, check to make sure that the probe’s electrical contact points are dry. As with preventative maintenance of any probe, make sure that the pH probe is rinsed with distilled/deionized water between use and cleaned periodically per the manufacturer’s specifications. Overnight storage generally requires placement of the probe into a 2-molar (M) solution of potassium chloride. This solution may cause an unwanted build up of salt, therefore, frequent rinsing may be necessary.

#### 6.9.2.2.6.4 Temperature of Calibration Solutions

Correct field measurement of dissolved oxygen, conductivity and pH requires tight control over calibration solution temperature. Proper calibration calls for solution temperatures of these parameters to be the same as the groundwater being measured (<http://water.usgs.gov/owq/FieldManual/Chapter6/6.2.1.html#HDR6.2.1.CAL1>). This may be difficult to achieve when field sampling well to well as groundwater temperature can vary between wells based on depth, local setting (asphalt vs. open field) and other atmospheric and hydrogeological factors. In addition, it is logistically difficult to bring solutions to groundwater temperature at the point of pump intake without first installing the pump, collecting purge water and allowing sufficient time to bring calibration solutions to appropriate temperatures.

For the purposes of LFPS in New Jersey, calibration solution temperatures and the flow-through cell itself must be maintained at approximately 54° F (12° C  $\pm$  2° C) during calibration. When ambient conditions warrant, this will require the suspension of the solutions and flow-through cell in a container/bucket of water at the aforementioned temperature. When calibrating for dissolved oxygen, always make sure the cell is vented to the atmosphere by attaching short pieces of tubing to the inlet and outlet fittings while the cell is submerged.

**SHEET** \_\_\_\_\_ **OF** \_\_\_\_\_

[illegible]

**\* INDICATOR PARAMETERS HAVE STABILIZED WHEN 3 CONSECUTIVE READINGS ARE WITHIN:  $\pm 0.1$  for pH;  $\pm 3\%$  for Specific Conductivity and Temperature;  $\pm 10$  mv for Redox Potential; and  $\pm 10\%$  for Dissolved Oxygen and Turbidity.**



## Field Instrument and Calibration Data Sheet

Site: _____		
Field Personnel: _____		
Date: _____	Start Time: _____	Stop: _____

Meter (make/model)	Probe
DO _____	_____
pH _____	_____
Spec. Cond. _____	_____
ORP _____	_____
Turbidity _____	_____

Dissolved Oxygen	Turbidity	ORP
	Standard      Reading	
Water Temp _____	D.I. Water _____	Standard Temp. _____
Baro. Pres. _____	_____	Standard Conc. _____
Saturation _____	_____	Initial Reading _____
Init. Mtr. Rd. _____	_____	Meter reset to _____
Mtr. reset to _____	_____	
O <sub>2</sub> Satur. % _____	_____	

Specific Conductance				
Conc.	Initial Reading	Reset to	Temperature	Lot # and Exp. Date
Standard #1 _____	_____	_____	_____	_____
Standard #2 _____	_____	_____	_____	_____
Standard #3 _____	_____	_____	_____	_____
Standard #4 _____	_____	_____	_____	_____

pH Calibration					
Buffer	Temperature	Initial Reading	mV	Meter Reset To	Lot # and Exp. Date
4	_____	_____	_____	_____	_____
7	_____	_____	_____	_____	_____
10	_____	_____	_____	_____	_____

Monitor Well Information in Support  
of Pump Intake Depth Placement

Monitor Well	Screened/Open Interval			Intake Depth(s) (ft TOC)	Rationale for Pump Intake Depth(s)*
	Top (ft TOC)	Bottom (ft TOC)	Length (ft)		

ft = feet  
ft TOC = feet below Top of Casing  
\* If necessary, attach supporting documentation (e.g., boring logs, construction diagrams, soil sampling data, etc.).

During the purge phase, record the difference between the stabilized temperature and the temperature of the calibration solutions. This information must be presented to the end user. If the sampling event is extended for two or more days, appropriate adjustments can then be made to more accurately reflect the groundwater temperature during calibration.

#### 6.9.2.3 Low-flow Purging and Sampling for Low-Yielding Wells

The principal focus of water supply well installation is well-yield. In contrast, the principal focus of monitor well installation is water quality; well-yield is of secondary importance. In an attempt to locate and delineate ground water contamination, monitor wells are frequently installed in low-yielding water-bearing zones.

Low-yield wells present challenges with respect to representative ground water sample collection. The removal of water by bailers draws down the water-level in the well in slug-type increments. Peristaltic pumps draw water out of the well by vacuum (negative pressure) which may result in degassing and VOC loss. The operation of variable-speed submersible pumps at low-flow rates may result in heating of the sample as it flows around and through the pump, which may also lead to degassing and VOC loss.

Wells that yield less than 0.1 Lpm (100ml/min) frequently incur significant drawdown during well purging. If drawdown occurs across the screened interval or open borehole of a well, VOC loss may result. The increased stress on a well caused by significant drawdown may also result in an increase in well water turbidity. NJDEP recognizes that the use of sampling methods for LFPS discussed above may be impractical if drawdown cannot be limited. In an effort to facilitate the collection of a representative ground water sample from low-yielding wells, NJDEP will allow special sampling procedures to be used. This may include sample collection without regard to monitoring water quality indicator parameters associated with well stabilization.

At a minimum, water quality data, well construction data, water-level data, and accurate well-yield data for each low yielding well will need to be submitted to the Department prior to the formulation of an acceptable sampling procedure. Since sample collection may begin almost as soon as purging is initiated, it is imperative that the exact interval where the sample will be collected along the screen be predetermined. Aside from the considerations for monitoring drawdown and WQIP, all other aspects of LFPS may be found in the section above. The owner of the well shall also propose possible explanations for the low-yield of the well(s). Once the aforementioned information has been received, the Department will work with the well owner to formulate an acceptable sampling plan. The sampling plans will be approved on a case-by-case basis and will be well specific. Implementation of any special sampling procedure shall not be undertaken without prior NJDEP approval.

#### 6.9.2.4 Volume-Averaged Purging and Sample Collection

Application of water supply well construction practices to remedial investigations often resulted in monitor wells with open boreholes or screens of up to twenty-five feet in length. Previous NJDEP guidance specified that the standard well purging procedure was to calculate, in gallons, one volume of standing water within a monitor well and purge three to five times that amount. Over the past decade, much information has shown that this procedure may have produced data of questionable value. Today, the general consensus is that ground water contaminants in a heterogeneous subsurface often flow within thin or narrow zones of higher permeability. Purging large volumes of water from wells with long screens situated in a heterogeneous aquifer

creates a situation where ground water in the contaminant-bearing zone may be diluted by uncontaminated water entering the well from one or more “clean” zones. Utilizing poor well development techniques following well construction may exacerbate this dilution process in wells with long screens. The resulting condition is responsible for what is now acknowledged as a volume-averaged sample.

It should be noted that data generated from volume-averaged sampling can provide useful information regarding the contamination present in ground water. Indeed, volume-averaged sampling has been considered to be a conventional method of sampling monitor wells for years. If contaminant concentrations are not diluted below method detection limits, use of the method allows identification of the contaminants present in the ground water. A properly executed remedial investigation using this method can be used to monitor plume movement. The information generated, however, may fall short when evaluating the extent of a plume, true contaminant loads and, ultimately, the information needed to design a remedial action. Another example, where data generated under volume-averaged conditions remains valid, is potable sampling used for contaminant identification during homeowner/residential well investigations. This sampling method is a cost-effective means of determining whether contaminants have impacted potable wells and, if so, the potential level of risk to the well owners.

Sample collection equipment and the procedures for their use, when employing volume-averaging methods, are discussed in Chapter 5.

Because volume-averaged sampling involves purging a specified volume of water (i.e., 3 to 5 well volumes) and does not involve setting a pump intake in a specific screened or open bore-hole interval, there is no basis to justify the recording of any water quality indicator parameters typically monitored during LFPS. During a volume-averaged sampling event, the pump intake location can be set either immediately above the well screen or at the top of the water column. If the intake location is immediately above the well screen, and there is more than three feet of standing water above the pump, then the pump must be a positive-displacement pump since the sample will have to be collected through the pump. If the intake location is at the top of the water column and the depth of water is less than twenty-five feet, either a positive-displacement or suction-lift pump may be utilized. If a suction-lift pump is utilized for purging, samples must be collected by another means, typically via bailer.

Not all wells respond similarly to purging. Thus, the five ground water sampling categories listed at the beginning of this section were developed to match the best sampling technique to the well's design and the sampling objectives. Generally, **every** reasonable effort must be made to keep pumping rates low to avoid over-pumping or pumping the well to dryness. To accomplish this, pump rates may be adjusted and pumping times extended in order to remove the desired volume of water. Samples should be collected within two hours of purging. In no case should the time of sampling exceed 24 hours after purging. The evacuation rate of a monitor well should never exceed that of the rate used to develop the well to avoid altering the hydrogeological properties of the aquifer in the vicinity of the well. When sampling for VOCs, purging the well to dryness is unacceptable.

In some volume-averaged situations, evacuation of three-to-five well volumes may not be practical in wells with slow water-level recovery rates. If a well has been pumped to near dryness at a rate less than 0.5 gallons per minute, the well should be allowed to recover completely before sampling. If necessary, sampling within the two-hour limit may be exceeded to allow the well to recover sufficiently for sampling. In no case should the time of sampling exceed 24 hours after purging.

There are several reasons why the well should not be pumped below the level at which the ground water enters the well. First, water entering the well at the top of the well screen may cascade down the side of the screen. This cascading effect may aerate the ground water to be sampled, thus resulting in the loss of volatile organic compounds. Secondly, pumping to dryness can cause dehydration of the saturated zone; again, volatiles may be lost due to aeration within this zone. Additionally, other contaminants may adsorb to formation materials where a dehydrated zone is created. Finally, exposure of the filter pack to atmospheric conditions may have long term effects. As a result, samples collected upon the recharge of a well pumped to dryness may not accurately characterize ground water quality due to one or more of these effects.

There are many methods that may be used for well evacuation. Not all methods are acceptable under all conditions. The depth to the water table usually dictates the selection of an evacuation method. The preferred and most commonly used methods involve the use of a surface centrifugal or peristaltic pump when the depth to water is less than twenty-five feet, and, a submersible centrifugal pump when the depth to water is greater than twenty-five feet.

It is paramount to ensure that the evacuation procedure does not cause cross contamination from one well to the next. Therefore, the preferred method employs dedicated tubing and pumps. Since in many cases it may not be practical to dedicate a pump to a specific well, it is permissible to decontaminate this equipment between wells, if approved methods are used (refer to Chapter 2 of this manual). Tubing should always be dedicated to each individual well. Cleaned equipment entering the well should not be allowed to contact the ground or be compromised by any other potentially contaminated source (i.e., gasoline-fueled generators, purged ground water, surface water, vehicle exhaust, etc.). If this should occur, the compromised item should not be placed in the well or utilized for evacuation.

Prior to evacuation, check the well for floating product. The disposal or discharge of floating product or hydrocarbons, and the discharge of highly contaminated water may require special purge water collection and disposal procedures. During evacuation, drawdown should be kept to a minimum to avoid “overpumping” the well. However, if volume-averaged sampling is the objective, the pump intake or tubing shall be lowered if the water level drops and to ensure that all static water will be removed from the well prior to sampling. Regardless of the evacuation procedure used, the evacuation rate should not exceed that of well development. Overpumping will cause a “redevelopment” of the well resulting in collection of a turbid sample.

#### 6.9.2.5 Point Source (No-Purge) Sampling

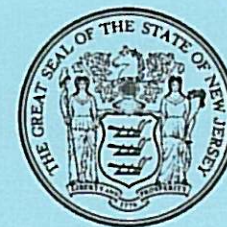
Point source sampling is a technique that utilizes a device specifically designed to obtain a grab sample of limited volume within the screened interval without the aid of, or disturbance caused by, well purging prior to sample collection. There are very few of these devices that are available on the market today, and the few that are must first be approved for use through an approved sampling plan. This is mainly due to their inherent design or function limitations, which restricts their broad application. Generically, these devices are only approved for use once the contaminants of concern have all been identified and the specific zone of contaminant flow in the screened interval/open borehole of the well has also been positively identified. This implies that these devices are more likely to be approved for operation and maintenance sampling where point source quarterly sampling supplements annual sampling performed using a pump for confirmation purposes. There may, however, be instances where deployment of multiple passive diffusion bag samplers in one well may be instrumental in determining the zone of contaminant flow. See below for a description of those devices approved for this technique and their associated advantages and disadvantages.

**APPENDIX B**

**LABORATORY ACCREDITATION DOCUMENTATION**



State of New Jersey  
Department of Environmental Protection  
Certifies That  
**Chemtech**



Laboratory Certification ID # 20012

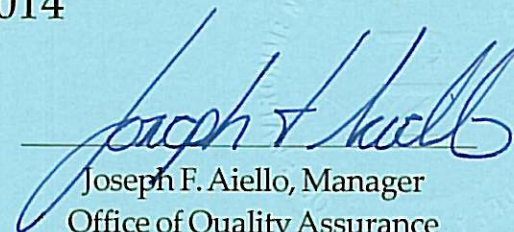
*is hereby approved as a*  
Nationally Accredited Environmental Laboratory  
*to perform the analyses as indicated on the Annual Certified Parameter List*  
*which must accompany this certificate to be valid*

*having duly met the requirements of the*  
Regulations Governing The Certification Of  
Laboratories And Environmental Measurements N.J.A.C. 7:18 et. seq.  
*and*  
*having been found compliant with the 2009 TNI Standard approved by the*  
The NELAC Institute

Expiration Date June 30, 2014



NJDEP is a NELAP Recognized Accreditation Body

  
Joseph F. Aiello, Manager  
Office of Quality Assurance

This certificate is to be conspicuously displayed at the laboratory with the annual certified parameter list in a location on the premises visible to the public. Consumers are urged to verify the laboratory's current accreditation status with the State of NJ, NELAP.





**LABORATORY  
ACCREDITATION  
BUREAU**



# Certificate of Accreditation

**ISO/IEC 17025:2005**

**Certificate Number L2219**

**CHEMTECH**

284 Sheffield Street  
Mountainside NJ 07092

has met the requirements set forth in L-A-B's policies and procedures, all requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the U.S. Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP).\*

The accredited lab has demonstrated technical competence to a defined "Scope of Accreditation" and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Accreditation valid through: October 20, 2015

**R. Douglas Leonard, Jr., President, COO  
Laboratory Accreditation Bureau  
Presented the 20<sup>th</sup> of December 2012**

\*See the laboratory's Scope of Accreditation for details of accredited parameters

\*\*Laboratory Accreditation Bureau is found to be in compliance with ISO/IEC 17011:2004 and recognized by ILAC (International Laboratory Accreditation Cooperation) and NACLA (National Cooperation for Laboratory Accreditation).